Federal Highway Administration
Intelligent Transportation Systems

Compendium of Field Operational Test Executive Summaries

Prepared by: BOOZ*ALLEN & HAMILTON

ITS

Field Operational Test

The Intelligent Transportation Systems Program is a comprehensive program aimed at applying advanced technologies to improve the safety and efficiency of our Nation's surface transportation system. The program is organized around four broad areas: metropolitan and rural travel management systems commercial vehicle operations, and intelligent vehicle initiatives. The program involves extensive research and development, operational testing of ITS systems and services and the fostering of actual ITS deployment.

U.S. Department of Transportation
Federal Highway Administration
Research and Development
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, Virginia 22101-2296

Field Operational Test Cross Reference

Title	Status (*)	Subject Area	FHWA Division
Adaptive Urban Signal Control Integration	I	ATMS	MN
Advanced Driver and Vehicle Advisory Navigation Concept	C	ATIS	IL
Advanced Rural Transportation Information and Coordination	I	ATMS/ATIS/ARTS	MN
Advantage I-75 Mainline Automatic Clearance Project	I	CVO	FL/GA/TN/KY/OH/MI
Alternate Bus Routing System	I	ATIS	NJ
Ambassador Bridge Intelligent Transportation Border Crossing System	I	CVO	MI
Anaheim Advanced Traffic Control System	I	ATMS	CA
Atlanta ATIS-KIOSK Project	I	ATIS	GA
Atlanta Driver Advisory System	C	ATIS	GA
Automated Mileage and State Line Crossing Operational Test	C	CVO	IA/MN/WI
Borman Expressway Advanced Traffic management System	C	ATMS	IL
Boston SmarTraveler	C	ATIS	MA
Capital	C	ATMS	DC
Colorado MAYDAY	I	ATIS	CO
Crescent	C	CVO	AZ/CA/NM/OR/TX/WA
Driver Information Radio Using Experimental Communications Technologies	I	ATIS	MI
During Incidents Vehicles Exit to Reduce Time	I	ATIS	MN
Dynamic Downhill Truck Speed Warning System	I	CVO	CO
Electronic Processing At International Crossings	I	CVO	AZ
Evaluating Environmental Impacts of ITS Using LIDAR Technology	C	ATMS	MN
Faster and Safer Travel through Traffic Routing and Advanced Controls	I	ATMS	MI
Genesis	C	ATIS	MN
Heavy Vehicle License Plate (HELP) One-Stop	C	CVO	AZ/CA/NM
Herald En-Route Driver Advisory System Via AM Sub Carrier, Phase II	I	ARTS	IA/CO
Idaho Out-Of-Service	I	CVO	ID
Idaho Storm Warning System	I	ARTS	ID
Integrated Corridor Traffic Management	I	ATMS/ATIS	MN
International Border Electronic Crossing	I	CVO	CA
Irvine Integrated Ramp Meter/Adaptive Signal Control	I	ATMS	CA
Midwest Electronic One-Stop Shopping	I	CVO	KS/IL/MN/MO/NE/SD/WI
Mobile Surveillance/Wireless Communication	I	ATMS	CA
Multi-Jurisdictional Live Aerial Video Surveillance System-Virginia	C	ATMS	VA
North Seattle Advanced Traffic Management Systems	I	ATMS	WA
Operation Respond	I	CVO	PA
Oregon Green Light Commercial Vehicle Operations Test	I	CVO	OR

Field Operational Test Cross Reference

Title	Status (*)	Subject Area	FHWA Division
Peace Bridge Intelligent Transportation Border Crossing System	I	CVO	NY
Puget Sound Emergency Response Operational Test	C	ATIS	WA
Real-Time Vehicle Emissions Detection	C	ATMS	CO
San Diego Smart Call Box	I	ATMS	CA
Seattle Wide Information For Travelers	I	ATIS	WA
Southwest Electronic One-Stop Shopping	I	CVO	AR/CO/TX
Spread Spectrum Radio Traffic Signal Interconnect	I	ATMS	CA
Texas Regional International Border Crossing System	I	CVO	TX
TransCal Interregional Traveler Information System	I	ARTS	CA
TRANSCOM System for Monitoring Incidents and Traffic	I	ATMS	NJ/NY
TransGuide	C	ATMS	TX
Tranzit *Xpress*	C	CVO	PA
Tranzit *Xpress* II	I	CVO	CA
Travel Aid	I	ARTS	WA
Travel Demand Management/Emissions Detection	C	ATMS	ID
Travel Technology	C	ATMS/ATIS	FL
TravInfo	I	ATIS	CA
TRAVLINK	C	ATIS/APTS	MN
Trilogy Advanced Traveler Information System Operational Test	I	ATIS	MN
Wisconsin/Minnesota Automatic Out-Of-Service Verification	C	CVO	MN/WI

(*) = Project Status as of April 1998: C = Test Completed; I = Test In Progress

APTS = Advanced Public Transportation System
ARTS = Advanced Rural Transportation System
ATIS = Advanced Traveler Information System
ATMS = Advanced Transportation Management System
CVO = Commercial Vehicle Operations

ITS Field Operational Test Summary
Adaptive Urban Signal Control and Integration

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Adaptive Urban Signal Control and Integration (AUSCI) ITS Field Operational Test uses advanced adaptive control technology to improve traffic efficiency on a grid network in Minneapolis, Minnesota. The network consists of 56 signalized intersections within the northern end of the central business district. AUSCI aims to enhance the effectiveness and responsiveness of traffic operations and control within this network. The network has historically been subject to increased variability of traffic flow due to incidents, special events, and special land-use characteristics.

The field testing of the components will start in September 1998 and end in January 2000. The Final Evaluation Report is expected in January 2000.

Project Description

The AUSCI system optimizes the operation of a grid network of 56 signalized intersections within downtown Minneapolis and coordinates freeway-arterial traffic management and control via ramp metering. The system uses SCOOT as its optimization and control engine. SCOOT is an acronym for Split Cycle Offset Optimization Technique. It is an adaptive control system that processes real-time traffic volume data to compute traffic signal timing parameters. The system changes these parameters in small increments, as necessary, to maintain an optimized signal operation. AUSCI aims to provide optimized, efficient, responsive, and flexible signal operations to accommodate variations in traffic flow due to incidents, special events, and special land-use characteristics.

Figure 1 depicts the project area consisting of a section of I-394 and applicable downtown surface streets.

The main objectives of the test are:

- Enhance corridor traffic management and control
- Evaluate adaptive traffic control system operation during major events and incidents
- Evaluate adaptive traffic control system effect at the boundary areas
- Evaluate the feasibility of installing and operating an adaptive traffic control system connected to the T2000C server
- Evaluate costs of the adaptive traffic control system versus using only the T2000C based system
- Evaluate system procurement effectiveness through a system partnership agreement
- Evaluate how well the installed system conforms to the design concept

- Evaluate interagency cooperation required to successfully operate an adaptive traffic control system.

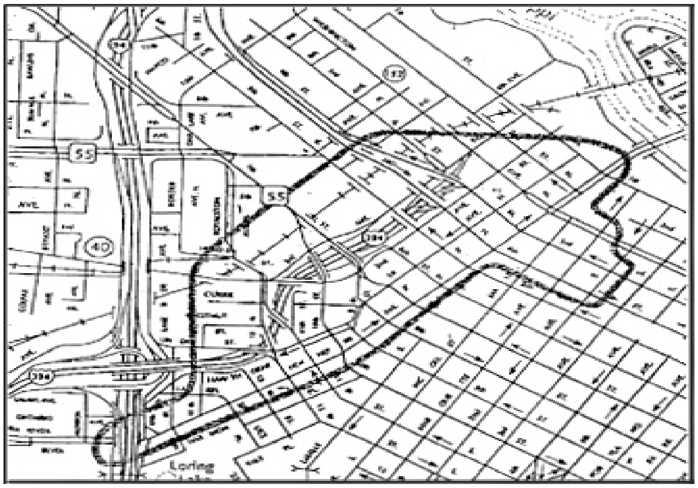


Figure 1: AUSCI Project Area

The AUSCI project is installing controller and cabinet equipment, system hardware, machine vision detection system, surveillance cameras, and additional communications links in the test area. The project is also developing, testing, installing, and integrating software to connect the SCOOT server to the current Minneapolis T2000C central server.

A total of 148 intersection approaches will be instrumented with a machine vision detection system to provide three types of outputs: detection data for SCOOT input, image data to the operator, and data collection for evaluation. Test partners chose a machine vision detection system to meet the detection needs of SCOOT since it is very detector-dependent.

The system operates using a T2000C server to process all communications to and from the field controllers. The SCOOT server links to the T2000C system and receives traffic input information after the T2000C server has translated it into a form usable by SCOOT. The SCOOT server runs its optimization algorithms and sends the signal control instructions to the T2000C server. The T2000C server formats the instructions and transmits them to the field equipment.

The test evaluates the performance, transportation impacts, deployment cost, and institutional issues associated with implementing the adaptive traffic control system.

Test Status

Test personnel are currently installing system devices and equipment and developing the system software. Test personnel will conduct an initial implementation phase in early 1998 to perform validation and acceptance testing. This initial implementation will encompass approximately 15 to 20 intersections.

Test Partners

City of Minneapolis

Federal Highway Administration

FORTRAN Traffic Control

Image Sensing Systems

Minnesota Department of Transportation

Westwood Professional Services

References

None published.

ITS Field Operational Test Summary

Advanced Driver and Vehicle Advisory Navigation Concept (*ADVANCE*)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The *ADVANCE* ITS Field Operational Test demonstrated the use of an in-vehicle advanced traveler information system in the northwest suburbs of Chicago, Illinois. It was expected to be the first large-scale dynamic route guidance system deployment in the U.S., resulting in the distribution of 3,000 in-vehicle devices. In late 1994, based primarily on the projected market limitations of what was likely to be an expensive system, the project partners scaled back the project scope, and agreed upon a targeted deployment of 75 in-vehicle systems.

Operational testing took place between June 1995 and December 1995.

Project Description

The *ADVANCE* system was designed to provide drivers, familiar with the area in which they were driving, with the fastest route to their destination through an in-vehicle traveler information and route guidance system. The system provided route guidance information using a static database of travel times and dynamic information on traffic conditions. The dynamic traffic information combined data from traditional roadside vehicle detection devices with data from *ADVANCE* system-equipped cars acting as traffic probes. The traffic information was reported to a Traffic Information Center (TIC) where a computer system determined the route with the shortest travel time to a set of predetermined destinations. The TIC then communicated the route information using radio frequency transmission to a Mobile Navigation Assistant (MNA) in an *ADVANCE*-equipped vehicle. Using this information, a driver could select a route to follow. The driver received Dynamic Route Guidance (DRG) to the selected destination via the selected route.

The tests compared driving times of vehicles using DRG to times of vehicles following static routes.

The objectives of the *ADVANCE* test were to:

- Assess the feasibility of providing DRG
- Assess the impact of DRG on travel time for drivers familiar with the arterial network
- Evaluate the use of probe vehicle data to characterize the traffic conditions on the network
- Evaluate the performance of the software algorithms for analyzing traffic input data and determining the shortest time routes
- Assess the user acceptance of and the performance of the in-vehicle Mobile Navigation Assistant (MNA).

ADVANCE consisted of five primary subtests.

- Traffic Related Functions (TRF) —component and system level software performance assessment

- TIC Architecture and User Interface—assessment of the function and ease of use of the Traffic Information Center (TIC)
- Incident Detection Study—assessment of the ability of the system to provide incident detection capability
- Familiar Drivers—assessment of user perceptions regarding usefulness/value of the system
- Yoked Driver Study—assessment of travel time savings.

Results

The *ADVANCE* tests demonstrated that it is feasible to use a Dynamic Route Guidance (DRG) system to improve travel times under certain conditions. The evaluation of the integrated system of computerized traffic information analysis software, in-vehicle advisory systems, and a dedicated radio frequency communication system showed that it is possible to collect, analyze, and communicate potentially useful information to drivers. This integrated system was able to provide drivers with information that allowed them modify their routes to use shorter time alternatives.

ADVANCE showed that the potential impact on travel times of the use of such an integrated system was measurable, although subject to some limitations. DRG provided the potential for motorists to reduce travel times by 4 percent, and potentially more under conditions of non-recurrent congestion. Some tests established that route diversions and travel time savings are sometimes associated with the use of real-time data for route planning. In an arterial network like that of the *ADVANCE* tests, in which DRG is subject to key functionality limitations, large time savings may not be a typical outcome. Where substantial savings occurred during the tests, the cause appeared to be the availability of less congested (but longer) alternate routes close to the highly congested routes. Such alternate routes, in the absence of DRG, are likely to appear illogical to drivers on the congested route. Drivers, therefore, are unlikely to find or follow these routes without a route planner using real-time information for the entire network.

A key component of the *ADVANCE* tests was the use of probe vehicles. In the Yoked Driver Study, the fleet of probe vehicles traveled between the origin-destination pairs over a variety of reasonable alternate routes shortly before the group of three test vehicles began their trip. Using the MNA, the probe vehicles reported their travel times on each link to the TRF at the TIC. The probe-reported results were compared to manually recorded observations of travel times over the same links. The reported travel times from the probe vehicles were highly accurate. A total of 99.4 percent of the reported values were found to be reliable and were included in the statistical sample. The comparison of reported times to manually recorded times showed that 87.6 percent of the probe values were within 5 seconds and 94.0 percent were within 10 seconds. A high percentage of the comparisons were within 2 seconds. The tests also showed that statistically accurate results are obtained using only a few probe vehicles. The tests demonstrated that three probe vehicles traversing a link within a 5-minute interval produced an accurate sample. Increasing the number of traversals beyond three produced only a minor increase in the accuracy of the measurement. The tests concluded that very high levels of probe deployment are probably not necessary for an effective probe-based ATIS.

Probe vehicles encountered some problems. The system operating concept required that each probe transmit its position at the end of each link. The testing found that this concept did not work well under heavily congested conditions, where traffic resulted in the probe being detained along the link, effectively preventing the determination of a link travel time.

The overall conclusion was that MNA data as deployed in *ADVANCE* provided a reliable indicator of traffic conditions and could thus be a valuable resource for traffic monitoring and analysis in future ATIS deployments. The results also argue strongly that probe vehicles can cost-effectively provide reliable data for developing real-time travel time estimates and projections.

One evaluation of the tests assessed the quality of the travel time prediction algorithm of the TRF. This algorithm used both probe and detector data to generate link travel time estimates for several 5-minute time intervals. These intervals began with the current interval and continued for 5-, 10-, and 15-minute intervals into the future. The predicted values were compared to recorded values experienced by the drivers of the test vehicles. The evaluation found that the algorithm accurately predicted travel times during off-peak periods, when the sampling rate was moderate, but tended to underestimate travel times during peak periods. This suggests that the prediction algorithm may have been calibrated too conservatively (e.g., somewhat too willing to ignore clusters of high probe travel time reports).

The familiar drivers who participated in the tests expressed some reservations about the usefulness of the MNA as a guidance tool for route selection. The drivers reported that the routes provided by *ADVANCE* were not particularly good and tended to be inferior to their own routes. This conclusion is consistent with the selection of drivers who were very knowledgeable of the arterial network in the test area. Drivers generally expressed a preference for having a greater degree of control over their choice of routes. They would prefer that the MNA "learn" their preferences as part of its functionality. The drivers did show a high level of interest in having access to real-time traffic information, especially concerning non-recurring congestion, such as that resulting from incidents. Most drivers envisioned the MNA as an "intelligent assistant" to their driving. Such an assistant would acquire the real-time data, evaluate the route chosen by the driver, and when appropriate, recommend more time-efficient alternatives.

Legacy

The *ADVANCE* TIC provided traffic management officials with valuable experience that they used to establish a much larger, more inclusive Corridor Transportation Information Center (C-TIC). This C-TIC provides real-time traffic information to a broad spectrum of interests in the Gary-Chicago-Milwaukee (GCM) corridor. The experience gained in the *ADVANCE* tests considerably reduced "shakedown" delays and setbacks that might have otherwise occurred in establishing the C-TIC.

Test Partners

- Federal Highway Administration (FHWA)
- Illinois Department of Transportation (DOT)
- Motorola
- Illinois Universities Transportation Research Consortium (University of Illinois at Chicago, Northwestern University)

References:

The *ADVANCE* Project: Formal Evaluation of the Targeted Deployment, Argonne National Laboratory, January 1997.

ITS Operational Test Summary

Advanced Rural Transportation Information and Coordination (ARTIC)

FHWA Contact :Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The ARTIC ITS Field Operational Test combines the communications dispatch operations of four public service agencies into a single communications center that serves a remote area in the Arrowhead region of northeastern Minnesota. The ARTIC partnership crosses state agency jurisdictions and functions, and fosters cooperation between highway and transit interests. This cooperation is critical in remote, rural regions where resources are limited and pooling of assets is necessary to satisfy the operational requirements of multiple agencies.

The goals of the project are to coordinate and pool resources to reduce duplication, improve transportation system efficiency, and improve user and driver safety. ARTIC responds to the challenges of providing transportation services in a remote area with low population density, a harsh winter climate, an aging population, and the inefficient use of existing transportation resources.

The testing phase began in October 1997 and is continuing. Evaluation of the project focuses on user acceptance and satisfaction, system technical and functional performance, system efficiency and effectiveness, system costs, and legal and institutional issues.

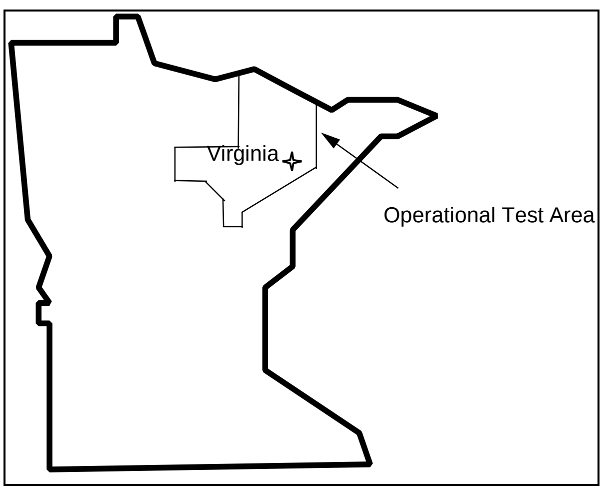


Figure 1: ARTIC Operational Test Area in Northeast Minnesota

Project Description

The test operation commenced in October 1997. Figure 1 illustrates the test area. A consolidated center located in Virginia, Minnesota, houses the emergency response functions and communications equipment for both the State Patrol and the Minnesota Department of Transportation (MnDOT). The center also houses the fleet management operations for Virginia Dial-a-Ride and Arrowhead Transit. Automatic Vehicle Location (AVL) devices and Mobile Data Terminal (MDT) equipment have been installed in 4 State Patrol cruisers, 15 MnDOT plow trucks, 12 Arrowhead Transit buses, and 3 Virginia Dial-a-Ride buses. This equipment provides operations personnel with the following features:

- Up-to-date information on vehicle location and availability
- Improved communications capability during emergencies.

The test implemented a computer-assisted transit scheduling system. The test also deployed a computer-aided dispatch (CAD) system to automate State Patrol call taking, communications, and records management functions. This deployment is part of a statewide program to expand the CAD system currently under development in the Twin Cities metro area to all Patrol districts outside the metro area.

The evaluation of the project focuses on

- User acceptance and satisfaction
- System technical and functional performance
- System efficiency and effectiveness
- System costs
- Legal and institutional issues

Test Status

The project began operations in October 1997. Data collection will continue until September 1998. The Final Evaluation Report is anticipated in December 1998.

Although system operations have just begun, the use of the communications facility is already yielding benefits. Anecdotal evidence exists that describes rapid responses to emergencies, particularly in winter conditions, that would not have been possible prior to system deployment. In one case, a MnDOT snowplow responded to a vehicle accident location in a fraction of the time that it would have taken for other law enforcement assets to respond. The snow plow operator was able to relay critical information to help resolve the accident situation.

All of the participating agencies are very enthusiastic about the project. The agencies look on the project more as an actual deployment than as a test. The transit agencies in the project have begun specifying that their vehicles be equipped with AVL technology as part of the original purchase. State agencies are already planning to include continuing operation funding in their respective budgets. In short, the participating stakeholders already consider the test a success.

Test Partners

Arrowhead Regional Development Commission

Arrowhead Transit

City of Virginia Transit

Federal Highway Administration

Minnesota Department of Transportation

Minnesota State Patrol

ITS Operational Test Summary

Advantage I-75 Mainline Automatic Clearance Project

FHWA Contact : Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Advantage I-75 Mainline Automatic Clearance Project ITS Field Operational Test consisted of a series of tests designed to evaluate different aspects of using the Mainline Automatic Clearance System (MACS). The project facilitated efficient motor-carrier operations by allowing transponder-equipped and properly documented trucks to travel any segment along the length of Interstate 75 at mainline speeds, bypassing most weigh or inspection stations. Advantage I-75 applied transponder technology and decentralized control while allowing each state to retain its constitutional and statutory authority relative to motor carriers and their operations.

The operational test has ended but the partners agreed to continue system operations for at least one year after the end of the testing period at their own expense. The Final evaluation report is expected in March 1998.

Project Description

The complete Advantage I-75 project consisted of four planned tests: Motor Carrier Fuel Consumption Test, Weigh Station Test, Jurisdictional Test, and System Test. In addition, portions of the test evaluation used a computer simulation. The four tests and the simulation intended to prove three hypotheses:

- Reduction or elimination of stops at weigh stations by trucks will produce measurable fuel savings
- Reduction or elimination of stops at weigh stations by trucks will produce measurable travel time savings
- Cumulative reduction or elimination of stops will create the potential to improve delivery times.

The Interstate 75/Highway 401 corridor stretches from Florida through Georgia, Tennessee, Kentucky, Ohio, and Michigan and continues into Ontario. Figure 1 shows the I-75/Highway 401 corridor.

The project equipped approximately 4,500 trucks with transponder devices that emitted the truck's unique identification code. Automated Vehicle Identification (AVI) readers were installed at 29 weigh stations on the I-75/Highway 401 corridor. When a transponder-equipped truck approached one of the AVI reader-equipped weigh stations, the reader identified the truck. Using information electronically recorded about the truck, the system verified its weight and credentials. The system signaled the truck to either by-pass the weigh station or enter it for weighing or inspection processing. The total time for this communication process was less than one second.

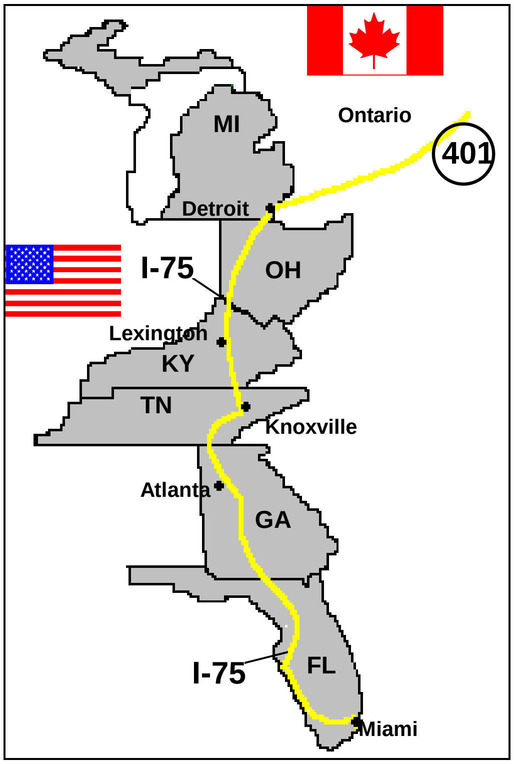


Figure 1: The I-75/Highway 401 Corridor

The Fuel Consumption Test was conducted under controlled conditions using nearly identical trucks operating over a loop of interstate highway. This test compared fuel usage between trucks that were signaled to stop at the weigh station and those that by-passed the station. This comparison tested the hypothesis that a reduction or the elimination of stops at weigh stations by transponder-equipped trucks will result in measurable fuel savings for each equipped truck.

In the Weigh Station Test, test personnel compared the difference in travel times of trucks electronically cleared to by-pass a weigh station to those that had to enter it. Test personnel also gathered information to run and validate the simulation program. This test attempted to prove that the reduction or elimination of stops at weigh stations by transponder-equipped trucks would result in travel time savings for that truck.

The Jurisdictional Test had two purposes. One purpose was to determine whether partner states intended to continue to offer the MACS (or some enhancement to it) and whether motor carriers intended to continue participating in the MACS. The second purpose was to identify issues and barriers to implementing the MACS. Test personnel conducted interviews with state officials and motor carrier decision-makers to collect their views on these issues. Test personnel also prepared questionnaires that the officials and decision-makers completed.

The System Test evaluated whether the MACS satisfied the goals of the project. The test compares the performance of the as-built MACS during the two-year project to the performance levels specified by project planning documents.

The Simulation used data collected during the Weigh Station Test to evaluate the effect that the MACS has on weigh station queue length and the number of unauthorized bypasses due to overcrowding. The simulation uses a previously developed and proven weigh station model. The simulation is necessary because the current percentage of transponder-equipped vehicles is too small to produce a noticeable effect on queues and bypasses.

Test Status

Data collection and analysis for the Advantage I-75 project continued until October 1997. The Fuel Consumption Test has been completed. The Weigh Station Test, the Simulation, the System Test, and the Jurisdictional Test are continuing. Final results will be available in March 1998.

The Fuel Consumption Test verified the basic hypothesis that reducing or eliminating stops at weigh stations would result in measurable fuel savings. Estimated fuel savings differed according to the type of scale at the weigh station. At static type scales, fuel savings were between 0.16 and 0.18 gallons per station. At ramp Weigh-In-Motion (WIM) type scales, the fuel savings varied between 0.06 and 0.11 gallons per station. At the single high-speed ramp WIM type scale, fuel savings averaged 0.05 gallons per station.

Legacy

Near the end of the Field Operational Test, the Advantage I-75 Policy Committee passed a motion to continue to provide electronic screening for a year beyond the conclusion of the FOT. The cost of the continuation is being borne by the state agencies involved. This action indicates that the partner states intend to continue to support the use of the MACS. Test participants are redesigning the MACS based on lessons learned during the FOT. Participants agree that the test promoted further deployment of ITS/CVO.

Test Partners

Kentucky Transportation Center, University of Kentucky

Federal Highway Administration

Florida Department of Transportation

Georgia Department of Transportation

Kentucky Transportation Cabinet

Michigan Department of Transportation

Several Motor Carrier Industry Firms

Ohio Department of Transportation

Ontario Ministry of Transportation

Tennessee Department of Transportation

References

Center of Transportation Research & Education, Iowa State University, <u>Advantage I-75 Motor Carrier Fuel Consumption Individual Evaluation, DRAFT Final Report</u>, July 1997

ITS Operational Test Summary

Alternate Bus Routing System (ABR)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Alternate Bus Routing (ABR) System ITS Field Operational Test communicates real-time route diversion recommendations directly to New Jersey Transit buses traveling north-bound on the Garden State Parkway (GSP). The system uses Vehicle to Roadside Communication (VRC) technology (such as transponders) as the communications link. The ABR Project will demonstrate how bus routing management technologies and strategies can be united to achieve goals of an Intelligent Transportation System (ITS). The test utilizes the resources of government, private industry, and academia to implement and test the ABR system. The test evaluated the system performance confidence, system reliability, and the user acceptance.

Phase I field testing took place in November and December 1997. Phase II, originally scheduled to begin in January 1998, has been canceled. The final Evaluation Report for Phase I is due in March 1998.

Project Description

The ABR system test area covers the north-bound GSP from the Raritan Toll Plaza to the New Jersey Turnpike (NJT) exit. Buses and private carriers enter the GSP at several interchanges, exit onto the Turnpike, and proceed toward New York City on the Turnpike. Depending on traffic conditions on the GSP, traffic managers may recommend that buses exit and use US Route 9, which runs parallel to the GSP. Once the buses enter the NJT, either from the GSP or from Route 9, traffic managers may communicate further information to the buses regarding traffic conditions on the inner and outer roadways. Figure 1 shows the project location.

The ABR system physical architecture consists of the following components:

- ***Remote Traffic Microwave Sensors (RTMS)*** that are located at four points along the corridor of the study area. These sensors detect volume, occupancy, and speed data on each lane and cover both the primary and alternate routes at New Brunswick Avenue, King George's Post Road, and NJT, Interchange 11. The detector located prior to Raritan Toll Plaza on the GSP collects data on the GSP, exclusively.
- The ***VRC Transponders*** are attached to each of the fifty buses being used in Phase I. Used as a secondary source of information, VRC transponders provide additional travel time information by enabling the automatic vehicle identification readers to identify buses by tag numbers, and track travel times and route selection decisions. To calculate travel times, the system software algorithm considers transponder and sensor information in a two to one weighting ratio. If the system detects no transponder data, it will use sensor data exclusively.
- The ***Audio Annunciators*** enable the communication of advisory messages to bus drivers from the New Jersey Highway Authority (NJHA) Traffic Operations Center (TOC) at Woodbridge, NJ. VRC transponders are located at the Raritan Toll Plaza, New Brunswick Avenue, and

NJT, Interchange 11. The ABR system evaluates traffic conditions north of the Raritan toll Plaza and gives bus drivers route guidance information near the Plaza. The system gives the route guidance message through an in-vehicle audio annunciator coupled to a VRC Transponder. Transponders north of the Toll Plaza may communicate additional information.

- A ***surveillance camera*** is located at the New Brunswick Avenue overpass. The camera is not directly linked to the decision making algorithm. However, it is helpful in monitoring the system through its full motion analog video transmission.

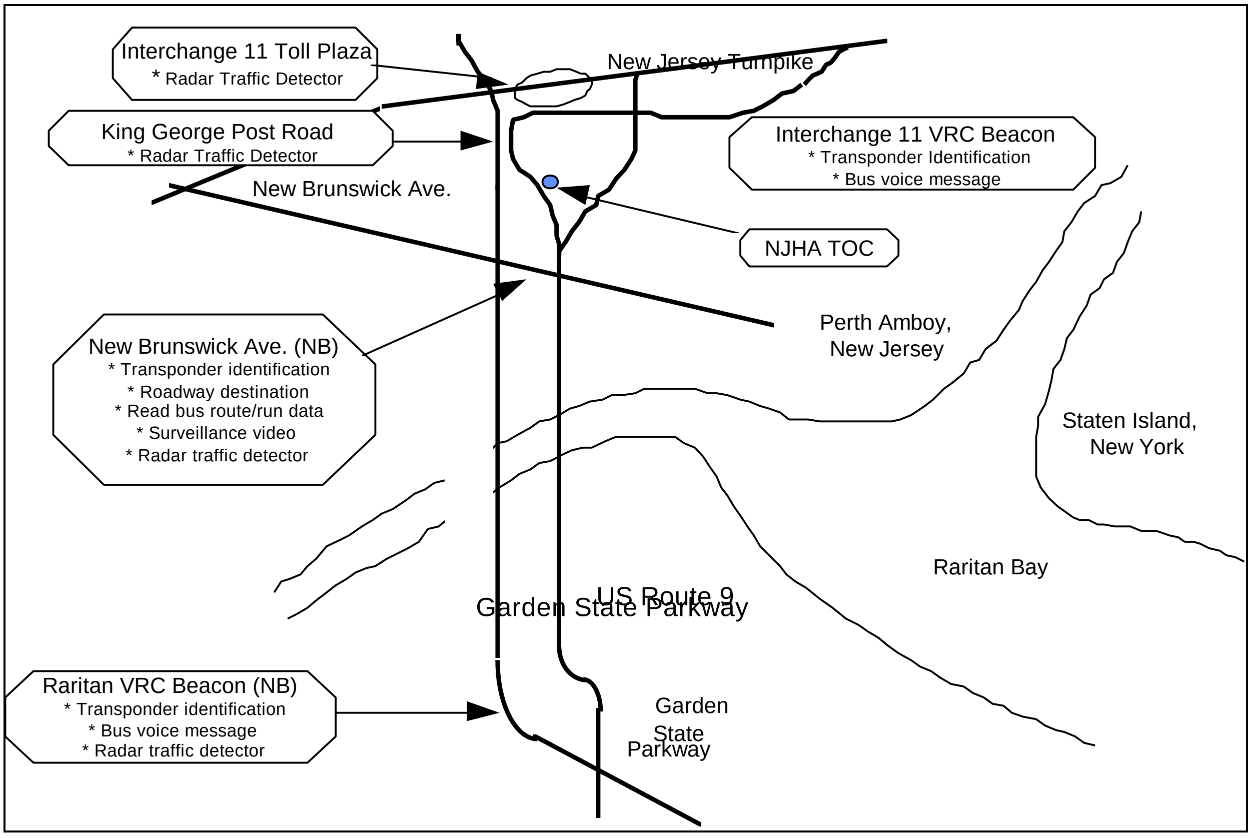


Figure 1: Alternate Bus Routing Project Location

The RTMS sensors sample flow, occupancy and speed data every 30 seconds for each lane and transmit this information to the TOC. At five minute intervals, the system calculates flow (vehicles/30 second), occupancy (percentage), and average speed (miles/hour) for each RTMS sensor. The algorithm then classifies the lane status as inactive, active, or failed. The ABR software stores the information by Route Number, Station, and Lane.

- After estimating travel time and delays for each route, the system algorithms may recommend a diversion at the Raritan Toll Plaza. The default route is the GSP. However, if delays on the GSP are excessive and the estimated travel time saving by using US Route 9 is significant, the ABR computer system will recommend diversion to the alternate route, US Route 9.

The evaluation of the results includes four tasks:

- Evaluation of Operation of Sensors and Spread Spectrum Radio Communications

- Evaluation of the Central Computer System
- Evaluation of In-Vehicle Operation
- Evaluation of the Performance of the Integrated System

Results

The project's independent evaluator prepared an evaluation summary report for Phase I. The following paragraphs summarize the findings of the report.

The ***Radar Sensors*** provided the ABR bus routing algorithm with volume, occupancy, and speed data for each of the four locations of the study site. The evaluators compared the real traffic volume (collected by evaluator through video output) to the volume counts supplied by the system. This comparison showed that real volume was 11.13% larger than that recorded by the sensors.

The evaluation of the ***Operation of the Central Computer System*** tested the routing system accuracy. The main system performance function was to correctly estimate the bus trip times for both routes, and to determine the travel time differences between the two routes. The evaluators found that the differences in travel times averaged between two and three minutes. This travel time difference is not statistically significant.

The evaluation of the ***In-Vehicle Operation*** involved audio message testing performed by activating the transponders on the instrumented vehicles during test runs to verify that messages could be received at normal highway speeds. During preliminary testing of each system component by the system designer/implementer the messages sent from the operation's center were heard at the proper location-approaching Raritan toll Plaza. Further, the messages were heard clearly during both clear and rainy weather and the intensity of the volume and clarity of the message was acceptable.

The evaluation of the ***Performance of the Integrated System*** involved observing the system's output of diversion messages and assessing user reaction to the system. The evaluators could not make a definite determination of the system's usefulness because few diversion messages were issued during the testing period. Regarding user reaction, the evaluator conducted informal interviews with the bus operators and found:

- 60% were enthusiastic about the ABR project's potential to improve travel time
- 63% of the operators did not find the diversion message clear, while 46% thought the sound quality could be improved
- 67% of the drivers were optimistic that the ABR system would improve travel time,
- 47% of the drivers believed that the alternate route provides an advantage after the diversion instruction.
- 80% of the drivers thought the diversion message was accurate
- 60% of the bus drivers agreed that the ABR system saves travel time
- 25% of the drivers diverted to US Route 9, when the diversion message instructed the operators to stay on GSP

- 85% of the operators agreed that the equipment is functioning effectively and was placed conveniently within the bus.

Test Partners

Federal Highway Administration

Hughes

New Jersey Department of Transportation

New Jersey Highway Authority

New Jersey Transit

New Jersey Turnpike Authority

Rutgers University

TRANSCOM

References

Rutgers University Departments of Civil and Industrial Engineering, Evaluation of the Alternate Bus Routing Project -- Phase I (Draft), December 1997

ITS Operational Test Summary

Ambassador Bridge Intelligent Transportation Border Crossing System

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Ambassador Bridge Intelligent Transportation Border Crossing System (ABBCS) ITS Field Operational Test demonstrates the use of ITS technologies to reduce the delays incurred by users of the Ambassador Bridge. This bridge crosses the Detroit River from Detroit, Michigan, in the United States to Windsor, Ontario in Canada. The project's goal is to enable commercial vehicles and daily commuters to cross a "transparent" international border. The main objective is to use ITS technology to facilitate the processing of vehicles and drivers through international border check points and to electronically pay bridge tolls.

The test operations commenced in May 1997 and are scheduled to be completed in November 1998, with the final report expected in March 1999.

Project Description

The international trade community and government officials responsible for customs, immigration, and transportation, must execute a complex set of transactions and inspections in order for vehicles, drivers, and cargo to cross legally and safely from one country into another. Because many of these transactions are conducted manually, the time required to process an individual shipment can be significant. At land ports, such as the Ambassador Bridge, commercial vehicle traffic volume has grown to the point where lengthy processing delays are commonplace. These delays impact the trade community by increasing costs, and adversely affecting the efficiency of operations. The increasing volume of commercial vehicles also has potential safety implications. As part of the IBC (International Border Clearance) Program, the Federal Highway Administration has worked with representatives from the Michigan Department of Transportation, the Ambassador Bridge, the US Treasury's North American Trade Automation Prototype (NATAP) program, and Canadian transportation officials to cooperatively address these issues.

The result is an IBC system that aims to significantly reduce administrative delays incurred by vehicles at international points of entry. The system also facilitates safety screening of commercial vehicles. The IBC system will facilitate trade and transport processing by supplanting current paper-based processes with one supported by electronic data interchange (EDI). It will address the safety of commercial vehicles operating in the State of Michigan, and throughout the US, by forwarding transport safety data obtained by the system to the nearest existing commercial vehicle weight and inspection facility. This data will be in a format consistent with those under development under the Commercial Vehicle Information Systems and Networks (CVISN) program, and will allow the Michigan State Police to effectively screen incoming vehicles for safety compliance.

The IBC system integrates dedicated short-range communications (DSRC) capabilities for trade and transport related commercial vehicle electronic screening, with toll collection and dedicated commuter lanes. The system polls transponders installed in approaching vehicles. Based on the vehicle identification transmitted by the transponder, the system accesses stored information to debit toll accounts and allow pre-cleared commuter vehicles and pre-screened commercial vehicles to pass without stopping. The system supports the exchange of information between the trade community and regulatory agencies responsible for customs, immigration, and transportation. Figure 1 shows the ABBCS overview

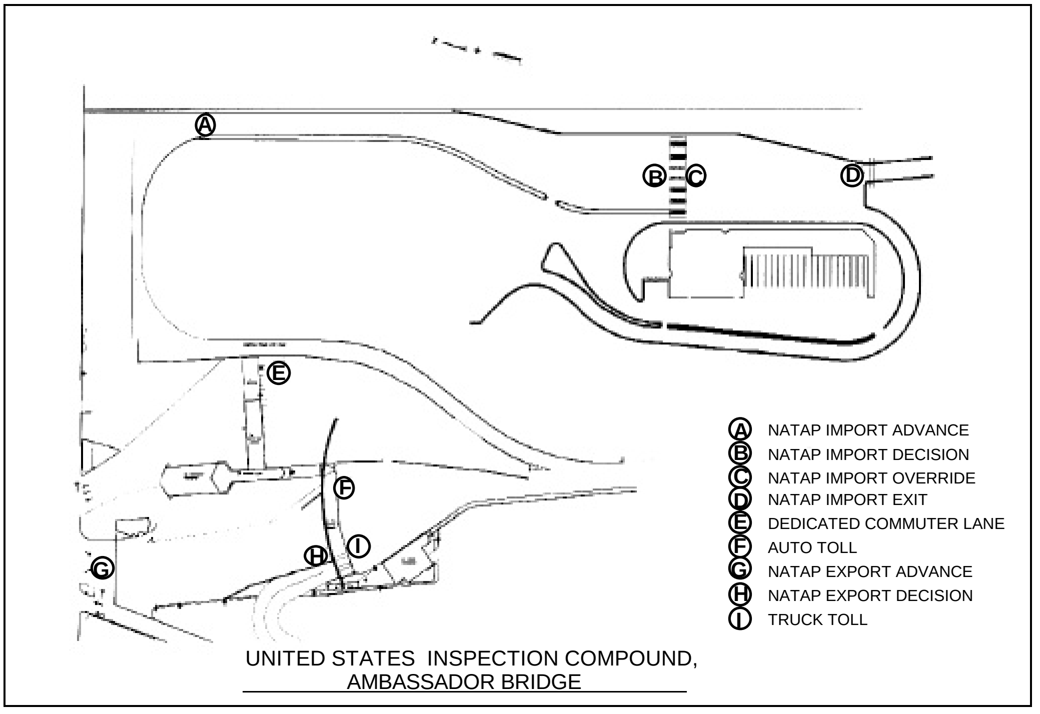


Figure 1: IBC System Overview

As a commercial vehicle approaches the border facility, the system electronically screens enrolled vehicles at the advance reader location using DSRC. The DSRC reads carrier, vehicle and cargo identification data, in the form of a trip/load number, from a transponder installed in the vehicle cab. The reader forwards this information through the IBC system to the NATAP system. When the vehicle reaches the US Customs primary inspection point, the decision reader reads the transponder a second time. This action prompts the IBC system to relay information received from the NATAP system to the display in the customs primary inspection booth. The NATAP information consists of immigration and trade related documentation regarding the status of the carrier, driver and cargo. Based on this information, the customs inspector instructs the driver to proceed either to the compound exit or to secondary inspection. A red or green signal, displayed both on the transponder and on a traffic signal adjacent to the primary inspection booth, relays the inspector's instructions to the driver. As the vehicle leaves the compound, the exit reader reads the transponder a third and final time. If the vehicle has completed all inspections satisfactorily and all required documentation is in order, the system gives the driver a green light to proceed.

The evaluation of the test will focus on the following goal areas:

- Assessment of the technical performance capabilities of the technologies
- Assessment of the user acceptance of the services and technologies being provided
- Evaluation of potential impacts of the services and technologies to the transportation processes and interfaces at all jurisdictional levels

- Documentation of transportation, institutional, and technical lessons learned

Test Status

System operation began in May 1997. Testing will conclude in November 1998. The evaluation will begin in the first quarter of 1998, with the final report scheduled for March 1999.

Test Partners

Detroit International Bridge Company

Federal Highway Administration

Michigan Department of Transportation

TransCore

References

None published

ITS Operational Test Summary

Anaheim Advanced Traffic Control System

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Anaheim Advanced Traffic Control ITS Field Operational Test is evaluating two advanced technologies. One technology is a low-cost video traffic detection system (VTDS); the other is an adaptive traffic signal control system, known as the Split Cycle Offset Optimization Technique (SCOOT). SCOOT was originally developed and marketed outside the US. The test has two purposes:

- Explore the issues associated with using above ground sensor technology, as an alternative to traditional induction loop detectors
- Assess the technical and performance issues related to using SCOOT in a US city.

The test took place in the City of Anaheim, in Orange County, California. The data collection for the VTDS component occurred in December 1996; data collection for the SCOOT component occurred in Fall 1997. A Final Report is expected in March 1998.

Project Description

The two technologies evaluated by this test were tested separately.

The VTDS component of the test provided an alternative means of vehicle and phase detection at traffic signal controlled intersections. The VTDS employs a video camera to observe traffic approaching and stopped at an intersection. Such a system avoids the installation and maintenance issues related to inductive loops embedded in the roadway. In addition, the VTDS offers the potential for increased surveillence coverage. The VTDS also allows more flexibility in changing the location of the video vehicle sensors at an intersection. Using the VTDS, a single camera, mounted in an overhead position (for example, on a cantilever signal support arm) can cover an intersection approach. Each camera can accommodate up to four traffic lanes. The test assessed the performance of the VTDS under a range of traffic, lighting, weather, and installation scenarios, by comparing VTDS vehicle presence outputs against manual observations. The VTDS did not replace the loop detectors for the purposes of this test.

The SCOOT component of the test consists of a deployment of SCOOT at 18 existing signal controlled intersections. Intersections to be included are principally on Katella Avenue, east of I-5. Figure 1 shows the SCOOT component test area. The test area includes the Anaheim Stadium (football) and the Anaheim Pond (ice hockey, concerts). The evaluation compared traffic conditions, before and after implementation of SCOOT during the afternoon peak, and evenings, for event and non-event days. Adaptive traffic control offers the potential for reduced traffic congestion and smoother traffic flow, by predicting when ‘platoons’ of traffic from one intersection will arrive at the next intersection downstream. During the intervening period, priority can be given to traffic on cross streets. SCOOT requires modifications to, but not replacement of, existing controllers. As part of the evaluation, test personnel will assess issues such as compatibility with existing controllers and loop detectors, and ease of installation.

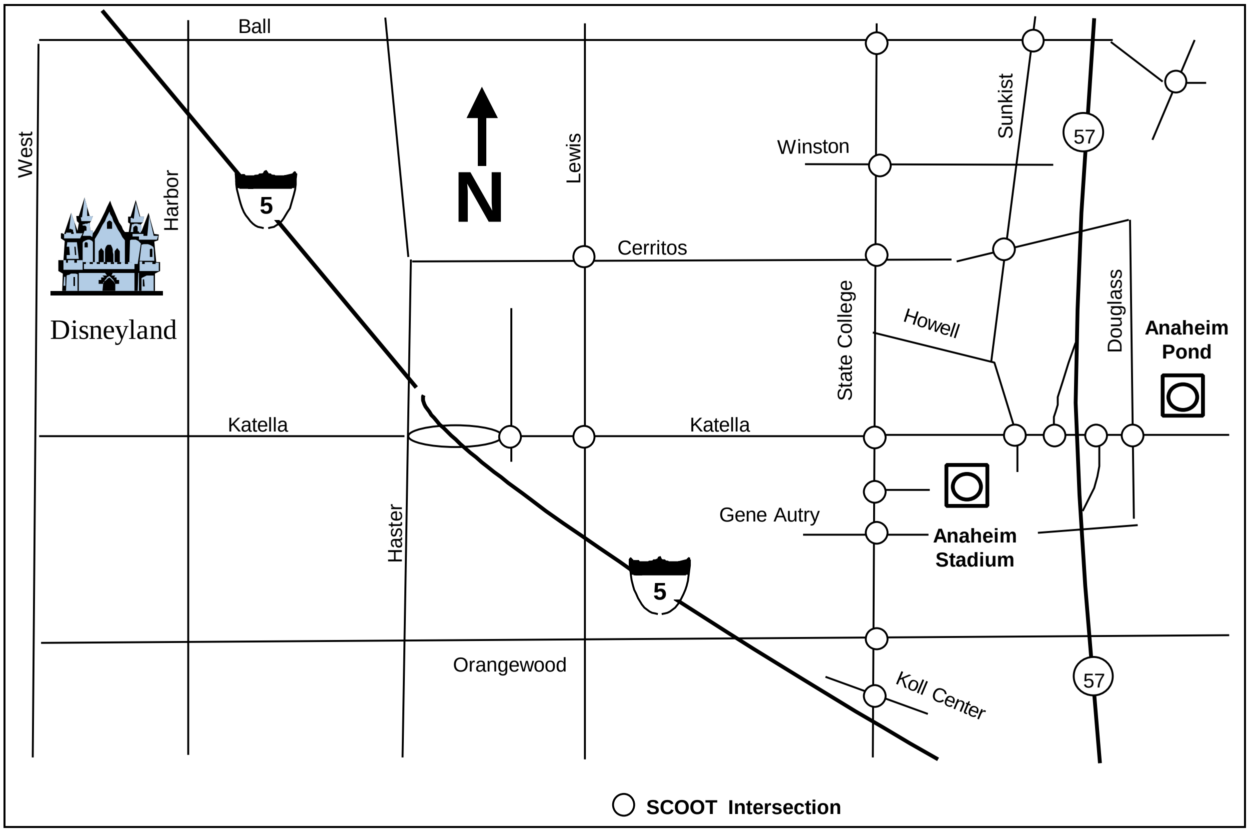


Figure 1: SCOOT Component Test Area

Test Status

Data collection was completed during December 1996 (VTDS) and October/November 1997 (SCOOT). The VTDS is not currently in use (it was tested off-line from intersection control). SCOOT remains operational for the 18 intersections involved in the test. The final report is due in March 1998. No interim results are available.

Test Partners

City of Anaheim

California Department of Transportation

Federal Highway Administration

Odetics (VTDS)

Transcore

References

None published.

ITS Operational Test Summary
Atlanta ATIS-KIOSK Project

FHWA Contact: Office of Travel Management and ITS Applications, (202) 366-0372

Introduction

The Atlanta Kiosk ITS Field Operational Test was the evaluation of an advanced traveler information system (ATIS) in Georgia. The purpose of the project was to provide the traveling public with a diverse base of pertinent information available through an easy-to-use interface located at many transportation interchanges. The kiosk system continued to operate after completion of the test and is available statewide through a system of over 130 kiosks. Available information includes route-maps, local attractions, real-time traffic and incident information, airport information, Metropolitan Atlanta Rapid Transit Authority (MARTA) information, and special events and Olympic Schedules (during the 1996 Summer Olympic Games).

Test personnel conducted data collection during the 1996 Olympic Games period in July and August 1996. A final evaluation report is expected in March 1998.

Project Description

As part of a larger ATIS project, the primary partners installed a network of 130 traveler information kiosks. Many of the kiosks were located in Atlanta but others were installed throughout the state. Kiosks were installed in locations through which travelers would be passing. These locations included MARTA stations, Hartsfield International Airport in Atlanta, interstate and highway rest areas, traveler welcome centers, and shopping and lodging centers. During the 1996 Olympic Games in Atlanta several kiosks were installed at Olympic Games Venues.

The kiosks provided users with up-to-date travel and event information. Each kiosk consisted of a power supply, climate control equipment (for those kiosks located outdoors), a computer, a touch screen monitor, and a printer, housed in a tall shell. The computer was connected to an information distribution network by a modem. A traveler could use the kiosk to obtain information on the best route to a destination, local attractions, real-time traffic and incidents, MARTA bus and train schedules, special events and Olympic Game Schedules (during the Games). Figure 1 shows a schematic of the kiosk system.

Travelers used a touch screen to interact with the kiosk. The computer displayed the information using a series of menu-driven screens. Travelers used a finger to touch buttons or menu choices displayed on the screen. The computer determined the location of the touch and displayed the appropriate information. Travelers could request a printed copy of some of the information.

Although test personnel completed data collection during the 1996 Summer Olympic Games, the system was not fully operational at that time. As a result, the data collected was not reflective of the full system. When the system was more fully operational, adequate funds were not available to resume data collection and the scope of the evaluation was reduced. The evaluation support contractor is completing a reduced evaluation focused only on the nationally significant benefits of the system.

Test evaluators used a variety of methods to collect and analyze information about the four evaluation areas. Evaluators distributed questionnaires and conducted interviews and focus groups. They conducted observational studies of user interactions with the kiosks and used technical experts to assess environmental and ergonomic factors. Evaluators also conducted a limited literature review. The kiosks maintained transaction logs that recorded the amount and type of kiosk usage. Information and combinations of information from these sources enabled test personnel to judge the accomplishment of the objectives and to make recommendations concerning the kiosks.

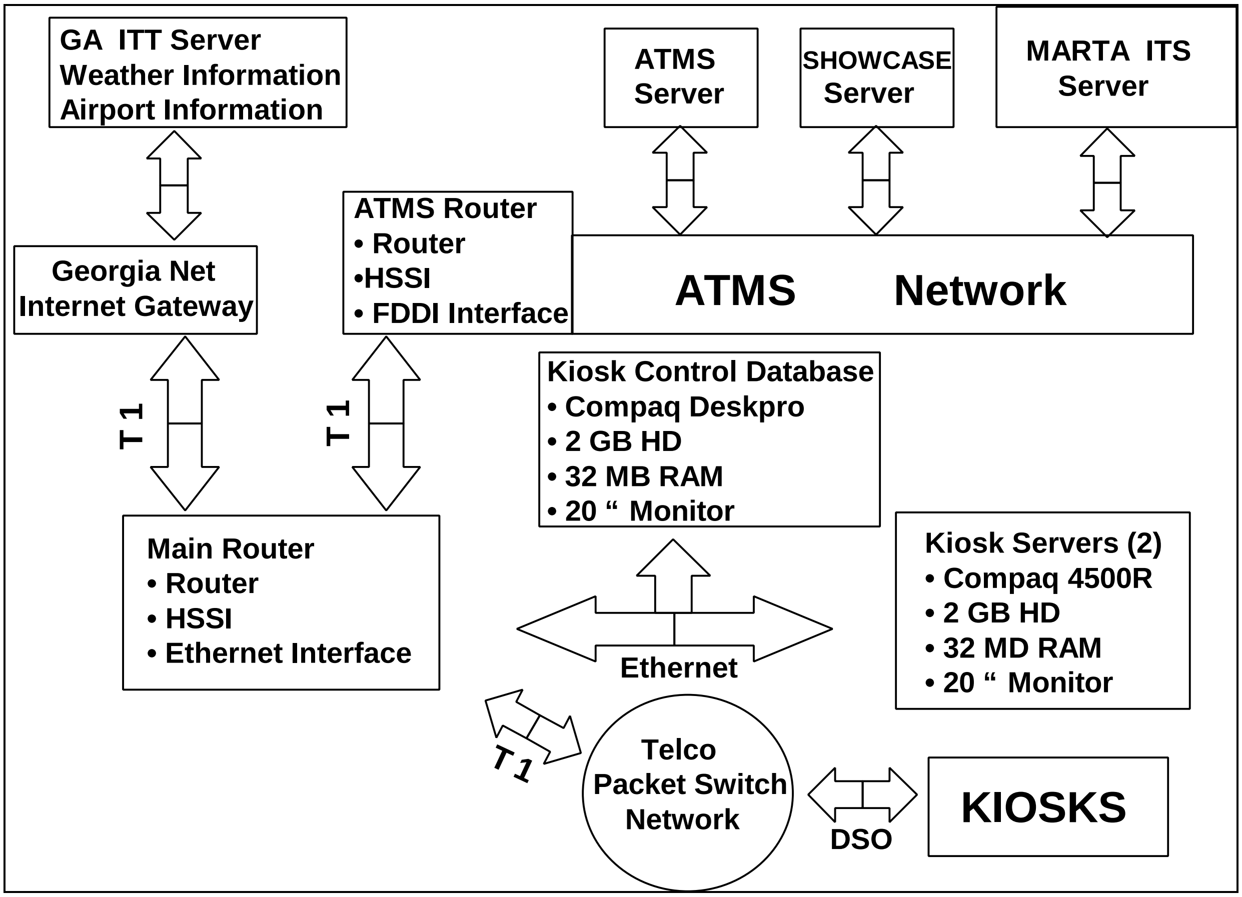


Figure 1: Atlanta Kiosk System Schematic

Results

The test evaluation was halted mid-way through its course, due to lack of funds. FHWA's evaluation support contractor developed and implemented a modified kiosk evaluation strategy. Under this strategy, the independent evaluator prepared only the User Acceptance Test Report.

The User Acceptance evaluation results reported principally on information gathered during the Olympics, but also included information collected at two tourist centers during the post-Olympic period. Evaluation results were presented using a five point scale with five being most positive, three being neutral, and one being most negative.

During the Olympic period, users rated the kiosks as providing information that was valuable (3.89), usable (4.15), attractive (4.27), understandable (4.33), and reliable (4.06). Users' overall satisfaction was 3.93. Users were close to neutral (3.21) about changing plans as a result of kiosk interaction. The most frequently accessed category was weather conditions (51.3%), followed by Olympic information (50%), travel and tourism (46.7%), and traffic information (35.5%). More than 60% indicated they would pay up to 50 cents to use a kiosk equipped with a printer. Users generally liked the graphics, icons, and touch screen interface but disliked the slow response time and insensitivity of the touch screen.

Results from the tourist centers produced similar results, but were slightly less positive compared to the Olympic period experience. The categories of information accessed in the post-Olympic period differed slightly. At the tourist centers, users wanted travel and tourism information (65.2%), weather conditions (56.5%), and traffic information (43.8%).

Overall, travelers who used the kiosks found them user-friendly and useful. The percentage of usage, however, remained low, varying from 8.6% of possible users at one tourist center to 0.1% at a busy MARTA station. Kiosks appear to be most used in locations where travelers have more time to make decisions or explore alternatives.

The FHWA's support contractor is performing a limited additional analysis of information from the fully operational system. The contractor is obtaining data on current kiosk system usage. The contractor will prepare an evaluation report on various kiosk usage characteristics. This information will be of use to other ATIS implementations in the US and elsewhere.

Legacy

The test partners have continued to operate the kiosk system following completion of the test. They continue to provide updated information to the kiosks in real-time. The kiosks continue to attract roughly similar rates of usage and the partners plan to continue operating the system.

Test Partners

Clark Atlanta University

Concord Associates

Federal Highway Administration

Georgia Department of Transportation

Georgia Net

Georgia Tech Research Institute

JHK (Transcore)

References

None published.

ITS Operational Test Summary

Atlanta Driver Advisory Service

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Atlanta Driver Advisory Service (ADAS) ITS Field Operational Test assessed a comprehensive Advanced Traveler Information Service (ATIS). In the Atlanta, Georgia metropolitan area, ADAS provided information to drivers of approximately 170 vehicles equipped with receiving units. The test data collection occurred from October to December 1996.

The main objective of the operational test was to evaluate the performance of the wide area driver advisory system, the two-way messaging system, and the local area driver advisory system.

Project Description

The ADAS communicated a selection of traveler information to specially equipped vehicles via three wireless links. The service provided congestion and incident alerts and local weather information. It also displayed current information on sports and entertainment events. As drivers traveled on the instrumented interstate highway, the service notified them of the next Interstate exit and informed them about the services available at the exit. The system also provided two-way messaging capabilities.

ADAS consisted of several subsystems. The Subcarrier Traffic Information Channel (STIC) subsystem of the Wide Area Driver Advisory (WADA) broadcast segment congestion levels, incident information, weather information, and event information via two FM radio stations located near central Atlanta. The Two-Way Messaging subsystem sent messages over a multiple channel, two-way radio link established on top of a central Atlanta building. This subsystem was capable of exchanging text messages with the vehicle drivers. The Local Area Transceiver (LAT) of the Local Area Driver Advisory (LADA) broadcast traveler services maps and in-vehicle signing from six short range transceivers located along Interstate 85.

Two other components completed the system. The ADAS System Controller (ASC) allowed operators to prepare, coordinate, transmit and receive messages and information. Georgia DOT's Transportation Management Center housed both the ASC and the DOT's Atlanta Transportation Management System (ATMS). The ASC extracted and relayed congestion and incident information from the ATMS. ASC operators entered weather and event information manually whereas in-vehicle signing and traveler service maps were preloaded into the ASC computer. The last component was the In-Vehicle subsystem that consisted of a mobile radio set, a global positioning system (GPS), a data processing interface unit and a display system. Figure 1 presents a block diagram of the ADAS components and their linkages.

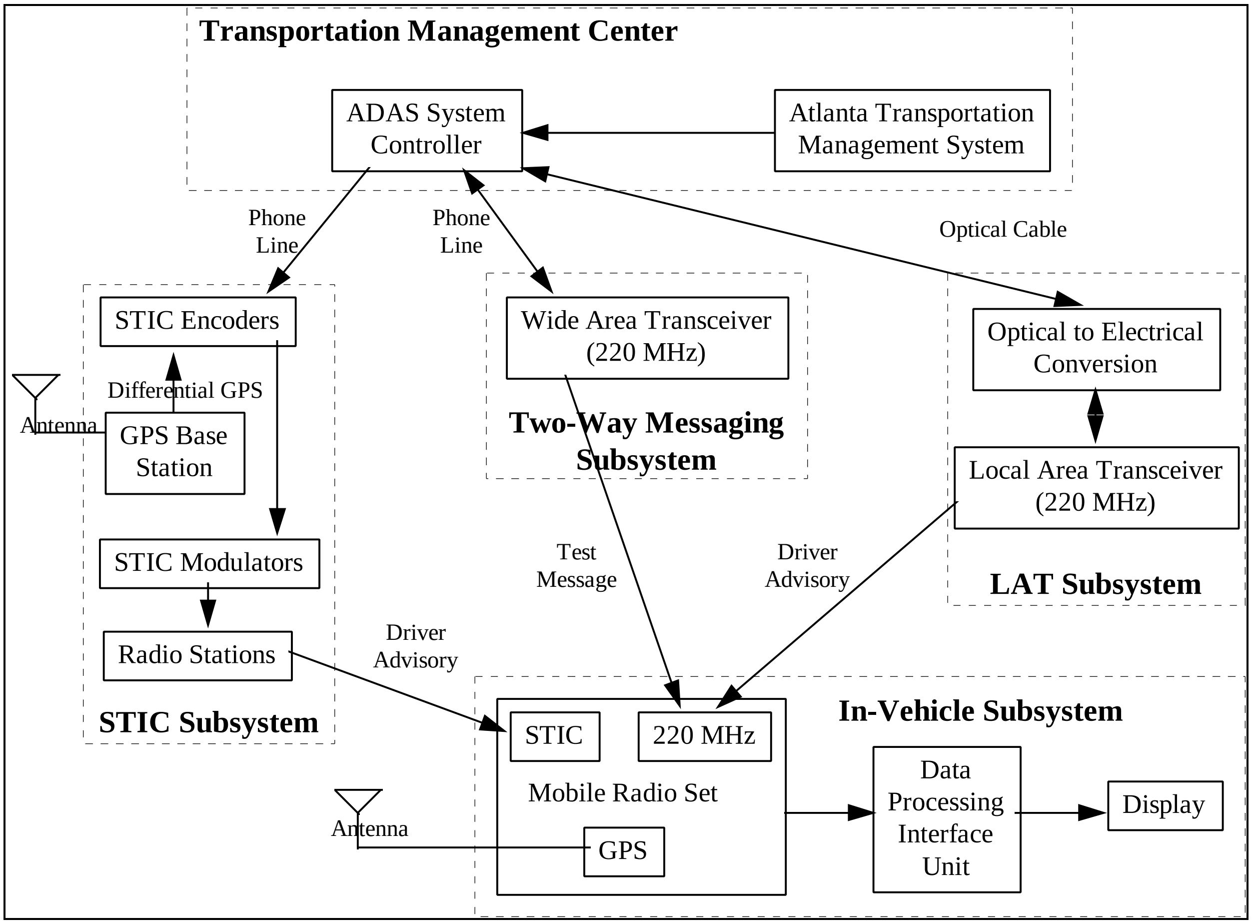


Figure 1: ADAS Block Diagram

ADAS operation consisted of preparing and transmitting information at the ASC and receiving and exchanging information in the test vehicles. When the driver started the test vehicle, the in-vehicle subsystem automatically displayed a metro map screen on the display. The subsystem overlaid congestion and incident information on the map, based on information received over the STIC. The driver could change the display by touching one of three buttons on the screen. Different buttons would display the events screen, the send message screen, or the current roadway screen.

The metro map was divided into 16 sectors. The driver could zoom the display in and out of a sector by touching the sector on the metro map. The map screen displayed congestion information on segments of the interstate system by presenting one of four icons representing different ranges of traffic speeds next to the segment. From any of the zoom screens, the driver could display text details of the congestion situation by touching the desired congestion icon. The maps also displayed icons representing incidents adjacent to the segment where they had been reported. The driver could display text details of the incident by touching the desired icon on one of the zoom screens.

The Two-Way Messaging Service provided drivers full communication with the ASC. The driver could both send a message to the ASC and receive a messages from the ASC. The driver could initiate a message by touching the “Send” button on the message screen. The in-vehicle unit sent the message and the Wide Area Transceiver (WAT) received it, sent an acknowledgment to the vehicle, and transmitted the message to the ASC. The ASC received the message, recorded it and sent an acknowledgment, via the WAT, to the vehicle. During the test, only vehicle identification messages were sent. In an actual deployment, a driver could send various messages depending on the situation.

The LAT broadcast traveler service maps and in-vehicle signing. Based on the position of the vehicle as determined by the in-vehicle GPS, the in-vehicle subsystem would switch to the appropriate LAT frequency to receive information. The information consisted of in-vehicle signs announcing the next intersection and traveler service maps showing the services available at the upcoming intersection.

The test originally intended to evaluate the ADAS technical system performance, extendibility, compatibility with the national architecture and user acceptance of the system. The evaluation was reduced to include only the key features of the technical system performance because adequate funds were not available.

The evaluation of the test involved assessing technical performance aspects of the system against a set of desired hypotheses. Evaluators assessed the technical performance of the STIC subsystem, the Two-Way Messaging Service, and the LADA Service. In addition, evaluators commented on the extendibility of the ADAS system to other circumstances and locations and on the possible changes to improve the system.

Results

The overall technical performance of the system was less than the desired efficiency. The system was able to accomplish most of the planned functions but was not able to accomplish them consistently. It is well to note that these findings are based only on the partial evaluation that could be accomplished within the available budget. Evaluators only studied the technical system performance. If all the planned tests would have been accomplished, these results could have been interpreted differently.

The WADA demonstrated its capability to collect and transmit congestion and incident information from the ATMS to the vehicles. Reception of messages, however, was only around 58% instead of the desired 99% and coverage was only 48% instead of the desired 95%.

ADAS was able to demonstrate the capability of exchanging messages with test vehicles. The probability of successfully transmitting a message and receiving a reply averaged 70% rather than the desired 95%. Drivers received a notification of a successful message within 12 seconds and received a notification of an unsuccessful message in less than 40 seconds. During testing, the vehicles were in motion when drivers initiated a message. Evaluators felt that, since the messages were to simulate mayday messages, in actual operation, the sending vehicle would be stationary. From a stationary vehicle, evaluators felt that the number of successful messages would have been much less than the reported 69.7%. The 69.7% figure was based on vehicles in motion.

The LADA service successfully demonstrated its capability to transmit and receive traveler information. The in-vehicle systems were able to use the GPS to properly tune the receiver to the correct frequency to receive appropriate information. In some cases, however, the in-vehicle signs and traveler service maps did not appear with sufficient lead time before an exit.

Concerning extendibility, evaluators felt that standards must be developed before attempting to implement similar systems throughout the country. Among the possible improvements suggested were: better in-vehicle displays and positioning of displays, and synthetic voice assistance to supplement displays. Other suggested improvements included: increased coverage for the STIC and the Two-Way Messaging service, and more timely display of traveler service maps and in-vehicle signs.

Legacy

The use of the technology was discontinued at the completion of the test. STIC, the Subcarrier Traffic Information Channel, has been adopted as the roadside communication technology for the Metropolitan Model Deployment Initiative projects in Phoenix and San Antonio. This technology is also under consideration as the standard for long range roadside communication to vehicles.

Test Partners

Clark Atlanta University

Concord Associates

Federal Express

Georgia Department of Transportation

Georgia Tech Research Institute

Oak Ridge National Laboratory

Scientific Atlanta

TRW

References

Garnto, I. (Georgia Tech Research Institute); System Performance Test Report from the Independent Evaluation of the Atlanta Driver Advisory System, Final Draft, August 1997

ITS Field Operational Test Summary
Automated Mileage and State Line Crossing Operational Test (AMASCOT)

FHWA Contact: Office of Travel Management and ITS Applications, (202) 366-0372

Introduction

The AMASCOT ITS Field Operational Test demonstrated and evaluated the feasibility of automating the collection of mileage-by-jurisdiction data and electronic data interchange (EDI) for International Fuel Tax Agreement (IFTA) and International Registration Plan (IRP) reporting. The test demonstrated the capability of automated mileage reporting to reduce time and paperwork necessary for motor carriers to comply with and for states to administer the regulatory processes for vehicle licensing, permitting and fuel tax filing, thus enhancing productivity of motor carriers and state agencies. The project originated in 1993.

Project Description

The test involved the motor carrier regulatory agencies in the states of Iowa, Minnesota and Wisconsin and 30 specially equipped interstate commercial trucks which collected mileage-by-jurisdiction data as they operated throughout the United States and Canada. For three months the data was transmitted by satellite to the vendor supplier and then transferred to the Independent Evaluator facility, which simulated the role of motor carrier operations data handling. Auditors from the three states examined the data for compliance with IFTA/IRP requirements. Figure 1 provides an illustration of the test configuration:

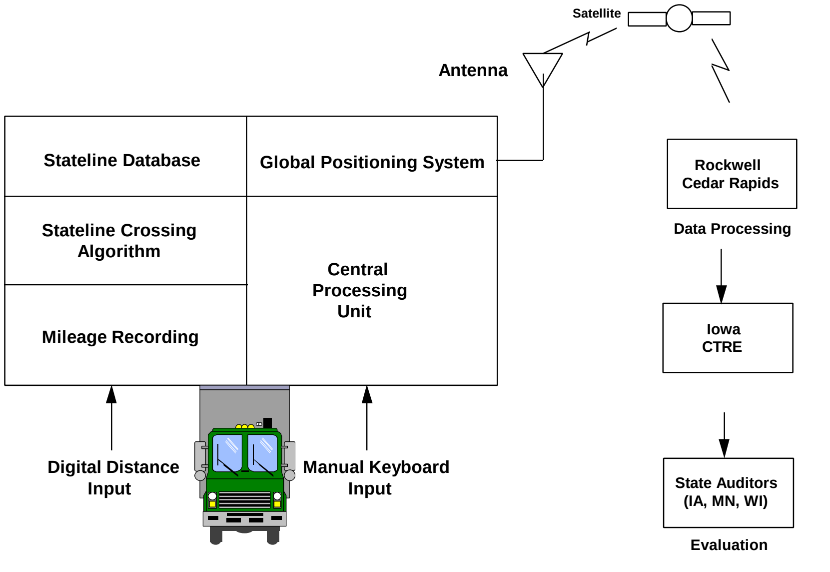


Figure 1. AMASCOT Test Configuration

The evaluation included three main components:

1. Truck System and EDI
2. State Agency Cost, Benefits and Acceptance
3. Motor Carrier Acceptance and Benefits.

The evaluation activities included detailed analyses of the EDI data for geo-location accuracy and data reporting consistency, as well as extensive interviews with state regulatory agency and motor carrier operators and administrators.

Results

From the Truck System and EDI evaluation, the following conclusions were made:

- Automated data collection using an electronic data path is feasible. It can meet IFTA an IPR requirements, and the motor carrier costs of integration are relatively affordable.
- Independent of the of state and motor carrier acceptance evaluation, these findings demonstrate the technical and practical feasibility of electronically collecting mileage by jurisdiction. This data can be integrated into both current systems and more advanced systems able to accommodate end-to-end electronic data paths for IFTA and IRP data collection, processing and reporting to a base jurisdiction.
- With the viability of the concept proven, states and motor carriers can move ahead to solve the related issues of EDI standards, EDI facilities and electronic funds transfer. They must also clear the way for implementation of similar technologies and processes for streamlining IFTA and IRP administration and compliance for both states and motor carriers.

From the State Costs, Benefits, and Acceptance evaluation, the following conclusions were made:

- The implementation of electronic mileage data collection and electronic filing for IFTA and IRP compliance promises benefits to states' IFTA/IRP data processing and auditing processes. Analysis of state agency IFTA processing and auditing processes identified potential benefits from electronic mileage data collection and electronic filing.
- States can benefit from automated electronic mileage data collection and electronic filing for IFTA and IRP compliance through reduced staff effort for data entry, increased integrity of the data received, reduced data storage requirements, and increased data accessibility and portability. The extent of these benefits will vary by state, and will be influenced by the rate of implementation of such systems by motor carriers.

- State auditing and processing supervisors agreed that the impact of electronic mileage data collection and filing on their systems depends on the level of implementation by home-state-based motor carriers, and that large impacts would not be realized until the implementation had filtered down to carriers of less than ten trucks.
- States face a number of institutional issues in implementing automated electronic mileage data collection and filing for IFTA and IRP. These issues have achievable solutions and many are being addressed through other efforts. The most significant turning point will be when the IFTA and IRP communities acknowledge acceptance of these technologies for compliance. Such acceptance will allow implementation of these technologies by states and motor carriers that perceive an appropriate level of benefit.

From the Motor Carrier Benefits and Acceptance evaluation, the following conclusions were made:

- The test demonstrated that technology is capable of automatically collecting mileage and routine data for IFTA and IRP compliance. Participating motor carriers found an excellent correlation between the test data and mileage and routine data collected by their drivers. These carriers also agreed that this data could easily be used to generate IFTA and IRP reports.
- Motor carriers participating in AMASCOT agreed that significant benefits could be achievable through automated mileage and route data collection for IFTA and IRP compliance. Primarily, benefits could be accrued through reduced data entry, reduced data errors and associated reconciliation, reduced paperwork, and electronic record keeping. A majority of these carriers identified significant potential cost savings from automated mileage and route data collection. These potential savings were estimated to be from 33 to 50 percent of current IFTA and IRP administration costs.
- Motor carriers identified privacy concerns associated with electronic mileage and route data, particularly related to limiting the use of and access to their data. They offered possible solutions to these concerns.
- Automated mileage and route data collection is most likely to be implemented by larger motor carriers with more technologically advanced business information systems. This is consistent with the conclusions of the evaluation of the costs of implementation. These motor carriers will pioneer the use of electronic mileage and route data collection for other business functions, ultimately demonstrating its economic viability and paving the way for more widespread implementation.

Legacy

The system ceased operations after the test concluded. The test was configured to demonstrate the technology and not for specific deployment purposes. This type of system, which is included as part of a package that provides other capabilities, is known to be offered by at least two commercial firms that provide the trucking industry with business information systems.

Partners

Iowa Department of Transportation
Minnesota Department of Transportation
Wisconsin Department of Transportation
ATA Foundation
Iowa Motor Truck Association
Minnesota Trucking Association
Wisconsin Motor Carriers Association
Rockwell International
Center for Transportation Research and Education
Federal Highway Administration

References

Automated Mileage and Stateline Crossing Operational Test Evaluation Summary - Final Report, Iowa State University, Center for Transportation Research and Education (CTRE), May 1996.

ITS Field Operational Test Summary

Borman Expressway Advanced Traffic Management System

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Borman Expressway ATMS Field Operational Test developed and evaluated the use of Advanced Traffic Management System (ATMS) technology along a three-mile section of the Borman Expressway in northern Indiana. The Expressway is a 16-mile stretch of Interstate 80/94 connecting the Indiana Tollway to the Illinois Tollway. The highway is one of the most heavily traveled expressways in the nation, carrying approximately 140,000 vehicles per day.

This operational test is Phase I of a project to establish an ATMS for the entire Expressway. The ATMS is a coordinated system of detection, communication, and response components controlled from a central management center. The ATMS will detect traffic incidents in real-time and provide traffic managers with a variety of tools to quickly respond to the incidents. The ATMS will help traffic managers mitigate delay and congestion on the expressway.

In Phase I, the Indiana Department of Transportation (INDOT) evaluated the use and viability of a variety of above-road vehicle sensing technologies and an advanced communication system. In Phase II (the actual deployment phase), INDOT intends to finalize the design and build the ATMS.

This field operational test (Phase I of the project) intended to independently assess the performance and applicability of a small number of vehicle sensors and the communication equipment connecting the sensors in the field to the central management facility.

Project Description

The field operational test installed, tested, and evaluated advanced technologies for traffic surveillance and communication systems. The traffic surveillance components measured basic traffic parameters including volume, speed, and occupancy of the traffic lanes. The test evaluated five traffic surveillance technologies including active microwave radar, passive infrared sensors, active ultrasonic sensors, active infrared laser radar, and traditional inductive loops. The communications components used several types of spread spectrum radio equipment as well as communications processors both at the remote sites and at the Traffic Management Center (TMC).

Test partners, led by the INDOT, installed and operated these components along a three-mile length of the Borman Expressway at three representative interchanges (Cline Avenue, Kennedy Boulevard, and Burr Street).

Phase I of the project installed and connected all ATMS components. The test evaluated:

- The system architecture, assessing the suitability of the data for traffic management algorithms and assessing the flexibility of the system for future growth
- The sensor technologies, assessing their performance and reliability

- The communications system, assessing its performance and potential interference problems
- The Incident Response Vehicle equipment, assessing its suitability and assessing the human operator factors
- The institutional issues, assessing the system's capability to integrate with existing local infrastructures.

The traffic surveillance equipment included video cameras and advanced vehicle detectors as well as inductive loops. The video cameras were used to detect incidents, monitor traffic flow, and provide visual information to emergency services during incidents. The test installed and evaluated 21 above-road (on overpasses, poles, and sign bridges) electronic sensors incorporating five technologies. These technologies included two different types of active microwave radar, an active infrared laser radar, a passive infrared sensor, and an active ultrasonic sensor. The traffic surveillance system measured basic traffic parameters (volume, speed, and lane occupancy) and preprocessed the data from the sensors

The tested communication system was an innovative application of spread spectrum technology. The spread spectrum technology compressed and transmitted voice, data, and video from the traffic sensors to an INDOT subdistrict. The communication system also linked the subdistrict to the TMC and linked the incident response vehicles to the traffic surveillance system.

The project also tested the concept of managing incident response directly from the incident response vehicle (IRV) rather than centrally from the TMC. The IRV was equipped with a radio link, an on-board computer, a video camera mounted on an extendible boom, and a GPS receiver. The IRV could clear up minor incidents, call for help from other authorities (police, fire, towing, etc.), operate the changeable message signs and the traveler information system, and design and implement detours.

Results

The evaluation of the system architecture was generally positive with some important reservations. The data collected by the traffic sensors is suitable for current traffic management algorithms. The data, however, may not be entirely suitable for future traffic management algorithms. For example, the currently installed detectors cannot classify vehicles as required by the congestion management systems under the Intermodal Surface Transportation Efficiency Act (ISTEA). In addition, although the temporal resolution of the detectors is sufficient, their spatial resolution may not be sufficient for traffic flow and vehicle counts on a lane-by-lane basis. In addition, the currently installed detectors cannot provide the functionality required to track vehicles from their origins to their destinations to develop origin/destination estimates and predictions. Evaluators considered that the surveillance system is flexible enough to accommodate near-term growth. They also found that the data processing equipment is sufficient for near-term growth but will probably require processors that are more powerful over a ten-year horizon. The communication system is flexible for future growth. In general, evaluators consider the overall system architecture to be flexible enough for growth in the next ten years but after that, the technology will likely require a substantial redesign.

Most of the sensor technologies did not meet the demanding criteria of the evaluation hypotheses. None of the sensors was able to detect 95 percent of the vehicles. The loop detectors suffered from calibration problems that could be easily corrected. The best of the above-road sensors (one of the active microwave radars) undercounted vehicles by about 10 percent. The 65 mph speeds and vehicle headways of less than one second made it extremely challenging for the current technologies. Only one technology (the same active microwave radar) met the 95 percent reliability requirement.

The communication system performed well and interference was at a negligible level. The transmission error rate remained within the acceptable level of the testing hypothesis. The majority of the field tests indicated that interference was not a significant problem, although the potential for interference will likely increase in the future.

The evaluators concluded that the IRV equipment was able to serve its intended function. They concluded that the required systems to support the IRV functions either exist or can be easily implemented. It is likely, however, that dynamic detour routes would be determined and coordinated at the TMC rather than at the IRV. The test did not collect enough data to determine the ability of the IRV operators to collect the required data and make correct decisions 99.5 percent of the time. Evaluators did, however, document satisfactory IRV operator performance.

The evaluation of the institutional issues produced mixed results. Although the IRVs were equipped to transmit automated emergency information, none of the emergency response agencies and establishments were capable of receiving the information in electronic form — these agencies still use telephones and manual records. These agencies are capable of receiving information via telephone but some do not yet have fax capabilities.

The evaluators concluded that Phase I of the Borman ATMS demonstrated the feasibility of the basic ATMS design. They felt that a cost-effective Phase II ATMS could be developed using the basic Phase I architecture. Several important issues must be addressed during planning for Phase II, including communication bandwidth requirements, performance and reliability of the sensor subsystem, and inclusion of other authorities and agencies.

Legacy

The field test of the technologies was Phase I of the project. INDOT has contracted the initiation of work on Phase II. The results of Phase I are being used in Phase II of the project.

Test Partners

Federal Highway Administration

Hughes Aircraft Company, Transportation Management Systems Office

Indiana Department of Transportation

References

Krogmeier, J et al., Borman Expressway ATMS Equipment Evaluation, Final Report, August 1996

ITS Field Operational Test Summary

Boston SmarTraveler

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Boston SmarTraveler Advanced Traveler Information System (ATIS) ITS Field Operational Test offered free, real-time, route-specific traffic and public transportation information via telephone to users in the Boston metropolitan area. The test proposed to assess the quantity and quality of information provided by the system, evaluate its public acceptance, and determine its impact on managing traffic congestion.

Phase I began in October 1992 and included a development and implementation period. Phase II began in January 1993 and was extended until March 1994. Phase II tested the operation and user acceptance of the system. Phase III of the project extended service until the end of 1994 to provide more time to operate the system and collect user responses.

Project Description

SmarTraveler operated in eastern Massachusetts, covering the Boston metropolitan area (see Figure 1). Conventional and cellular phone users could dial a number and receive travel information for one or more of 20 monitored highway segments, or for three public transportation services. Available information included traffic conditions, driving times, and anomalies (for example, accidents). The information did not include alternative route information. SmarTraveler used a proprietary audiotext system to store, organize, and disseminate travel information. System operators compiled the audiotext information from several sources, including video cameras, state police sources and probe vehicles. Operators also received information from up to three surveillance aircraft and from the Massachusetts Highway Department. Operators updated the system information continuously. System operators promoted the service through ads on local radio and television stations, promotional messages on variable message signs, media stories, interviews about the service, and distribution of flyers.

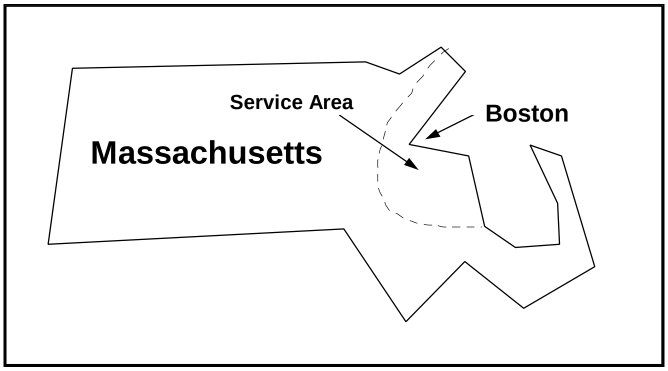


Figure 1: SmarTraveler Service Area

The evaluation team observed SmarTraveler operations and held discussions with representatives of transportation organizations that interacted with the system. Team members analyzed data obtained from calls to the service and conducted user and traveler surveys. They assessed the quantity and quality of information provided by SmarTraveler and evaluated the public acceptance and the utility of the travel information. Evaluators attempted to determine the impacts of the project on managing traffic congestion and to recommend improvements in the collection and dissemination of traffic information.

Results

The system collected extensive amounts of travel information, which led to the following findings:

- Awareness of SmarTraveler among the target population was limited, but the SmarTraveler user community contained a higher portion of upper income individuals than did the target population.
- Daily callers were impressed with the SmarTraveler service. Ninety-seven percent of the respondents indicated they would use the service again.
- Daily calls increased at a steady rate but did not reach a sufficiently high level during the test period to have meaningful impacts on congestion. A significant number of daily respondents, however, reported that the information they received from SmarTraveler had a direct influence on their travel behavior. Among these influences were changing departure times, using different routes, or canceling the trip.

The Evaluators concluded that utilization of the service by the public was below the level required to make a measurable impact on traffic congestion. With an increase in use, however, potentially enough people will modify their travel behavior to reduce or mitigate congestion.

Legacy

The project continues in operation as the ATIS portion of the Massachusetts ITS program. The Massachusetts Highway Department administers the program as a Federal-Aid funded program, with SmarTraveler under contract to provide the information services. The system is expanding from its early ties to telephone technology, and has expanded onto the Internet. Negotiations are underway for introduction to the regional television market.

Test Partners

Federal Highway Administration

Massachusetts Highway Department

Smart Route Systems

References

Multisystems, Inc., Evaluation of Phase II of the *SmarTraveler* Advanced Traveler Information System Operational Test, Final Report, July 1993.

ITS Field Operational Test Summary
Capital

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Capital ITS Field Operational Test focused on determining whether in-vehicle cellular phones could be used to provide traffic information in a more cost effective manner than traditional methods. Test personnel compared the cost of traffic flow information obtained using cellular phones to the cost using the existing system of induction loops and video cameras.

The specific objectives of the study were to:

- Determine the accuracy and completeness of traffic information derived from cellular phone geolocation data.
- Determine if traffic flow information obtained by triangulating in-vehicle cellular phone signals can be effectively integrated into a real-time wide-area traffic management system.
- Determine the costs associated with deploying such a wide area traffic monitoring system.

The test took place in the Washington D.C. area and covered a period of 27 months, ending in November 1995.

Project Description

The test installed commercially available direction finding equipment on approximately one fourth of the Bell Atlantic Mobile cellular towers in the test coverage area. Figure 1 shows the test coverage area and the location of the equipment for the direction finding system (DFS) and the Transmission Alert System (TAS). The TAS detected call initiation messages from cellular phones. The DFS attempted to accurately determine the position of vehicles using cellular phones by triangulating the cellular phone signal information obtained from at least four position fixes. During the cellular phone call, the system calculated one or more additional transmitter locations. Using multiple locations of the same cellular phone unit, a software algorithm calculated the vehicle speed. Using the calculated speeds from several vehicles in the same section of highway and comparing their calculated speeds to a database of “normal” speeds, another algorithm determined the likelihood of a traffic incident. In this manner, the system attempted to derive information similar to that obtained by induction loops and video cameras.

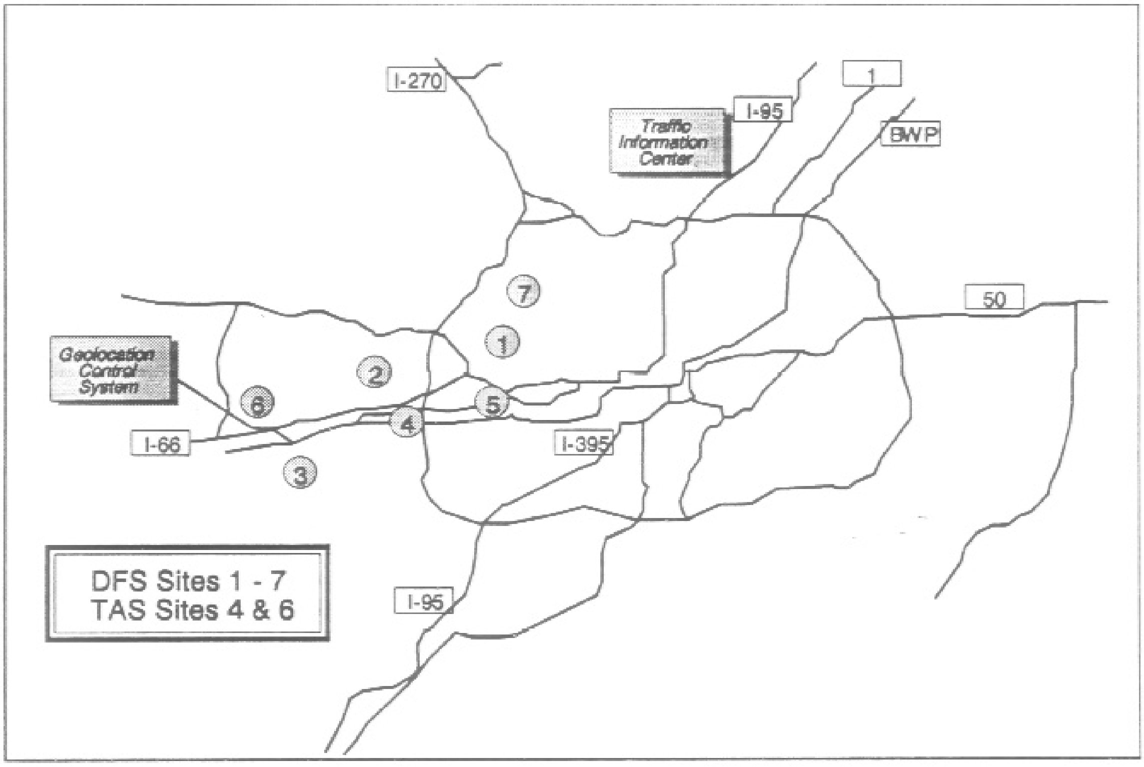


Figure 1: Test Area with Location of Direction Finding Equipment

The system included several methods to obtain accurate location information. To establish the accuracy of a single triangulation (fix), test personnel made cellular phone calls from known locations. The system then calculated the location of these "known" signals and used this information to calibrate other location information. In order to validate the accuracy of the speed calculations, test personnel drove five test vehicles with cellular phones through the area. Test personnel then compared the electronic driving logs to the speeds calculated by the system. The test also triangulated signals from cellular phones aboard random cars. Test personnel compared the resulting series of speed readings to police records of incidents in that area.

The test evaluated the system based on several factors: the accuracy and completeness of the data, the determination of the appropriate roles for the information, the determination of system costs and capabilities, and the public acceptance of the system.

Results

The Capital test was designed with high transmission power cellular phone technology in mind. During the test, however, new phones with substantially lower transmission power became prevalent. In an effort to adapt the test equipment to the new technology, the original test area was reduced to enable closer spacing of the direction finding equipment.

The system was able to determine vehicle location with reasonable accuracy. Using the minimum of two towers for triangulation, the system could calculate the location of a vehicle to within 150 meters. Using a third tower improved the accuracy to 108 meters. Tests with a moving vehicle confirmed that the system could distinguish traffic on highways from that on parallel and/or nearby arterial roads.

The system encountered problems when determining speed. Although the algorithm discarded some obviously erroneous readings and averaged at least three speed readings, the errors were large enough to invalidate 80% of all speed data.

Likewise, the automatic incident detection based on speed readings proved unsatisfactory. This was mainly because normal congestion produced very similar readings to readings measured during incidents. The evaluation found, however, that the speed readings could help an operator judge the traffic flow and detect incidents.

Test personnel compared the costs for the Capital system to the actual costs of the induction loop detection system on a representative part the highway network. They calculated that to provide a service similar to Capital in the 192 sq. mile area of the Washington DC-Baltimore corridor would require equipment installation at 23 towers. Such an installation would cost $2.7 million. An equivalent array of induction loops would cost at least $2.8 million (including work zone traffic control). Test evaluators noted, however, that induction loops provide additional capabilities (such as signal timing information) that the cellular system cannot provide. Test evaluators did not precisely calculate operation and maintenance costs so no comparison can be made.

Legacy

The operation of the system was discontinued at the conclusion of the test. No follow-up tests are currently planned. The technology used in this test has been superseded by the evolution of cellular phone technology.

Test Partners

Bell Atlantic Mobile Systems

Federal Highway Administration

Maryland State Highway Administration

P. B. Farradyne

Raytheon E Systems

Virginia Department of Transportation

References

Transportation Studies Center of the University of Maryland, Final Evaluation Report for the CAPITAL ITS Operational Test and Demonstration Program, May 1997

ITS Operational Test Summary
Colorado MAYDAY

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Colorado MAYDAY ITS Field Operational Test implements and evaluates an automated mayday system. The system allows users to request help and provides authorities with specific information about the location of the motor vehicle and the type of roadside assistance required. The test area includes the City of Denver and several counties in the northeast quadrant of Colorado. The test area covers about 12,000 square miles and includes both rural and urban roadways.

Phase I of the project concluded in 1995; Phase II concluded in 1997. Phase III has been canceled. The final Evaluation Report is expected in the second quarter of 1998.

Project Description

The proposed Colorado MAYDAY project was originally designed to be conducted in three phases. The test was then shortened to comprise only two phases. However, the evaluation plan was reconfigured to include in the final evaluation report the institutional, regulatory, and service provider issues that are relevant at both the local and national levels.

Phase I of the test developed, installed, and operated the prototype in-vehicle mayday units and other system components. Phase II assessed the accuracy of the system and determined its reliability and area of coverage using a limited number of prototype mayday units. Phase III proposed to assess the system performance using a larger number of prototype units and was to evaluate the preliminary user response to the system design.

The Colorado MAYDAY system consists of an in-vehicle device, a response center, and a dispatch center. Figure 1 presents a conceptual diagram of the MAYDAY system. The low-cost in-vehicle device is called TIDGET®. The TIDGET® provides Global Positioning System (GPS) data and contains the communications system control equipment. The user interacts with the TIDGET® through a button box. Depending on the distress situation, the user activates the appropriate button on the box and the TIDGET® processes the request. The TIDGET® then sends data on the vehicle's location and the requested service to the response center using the vehicle's communication system. The Colorado MAYDAY system uses an analog cellular two-way wireless communication system.

The response center receives all emergency assistance requests originating from the in-vehicle units. At the response center, computer software calculates the vehicle's position using the raw GPS data sent by the TIDGET®, supplemented by positioning information collected at the center. If the response center cannot determine the vehicle's location, the call defaults to voice mode. If the center can determine the location of the vehicle, the center sends the information to a dispatch center. Depending on the accuracy of the location determination, the response center may alert the dispatch center that the exact location may be in question.

From the response center, the dispatcher receives the caller, incident, and location information. The dispatch center establishes direct voice communication with the vehicle's operator. The dispatcher can view a screen display map of the caller's location and relevant information about the vehicle and operator. The dispatcher determines the needs of the caller and dispatches the appropriate response to the location.

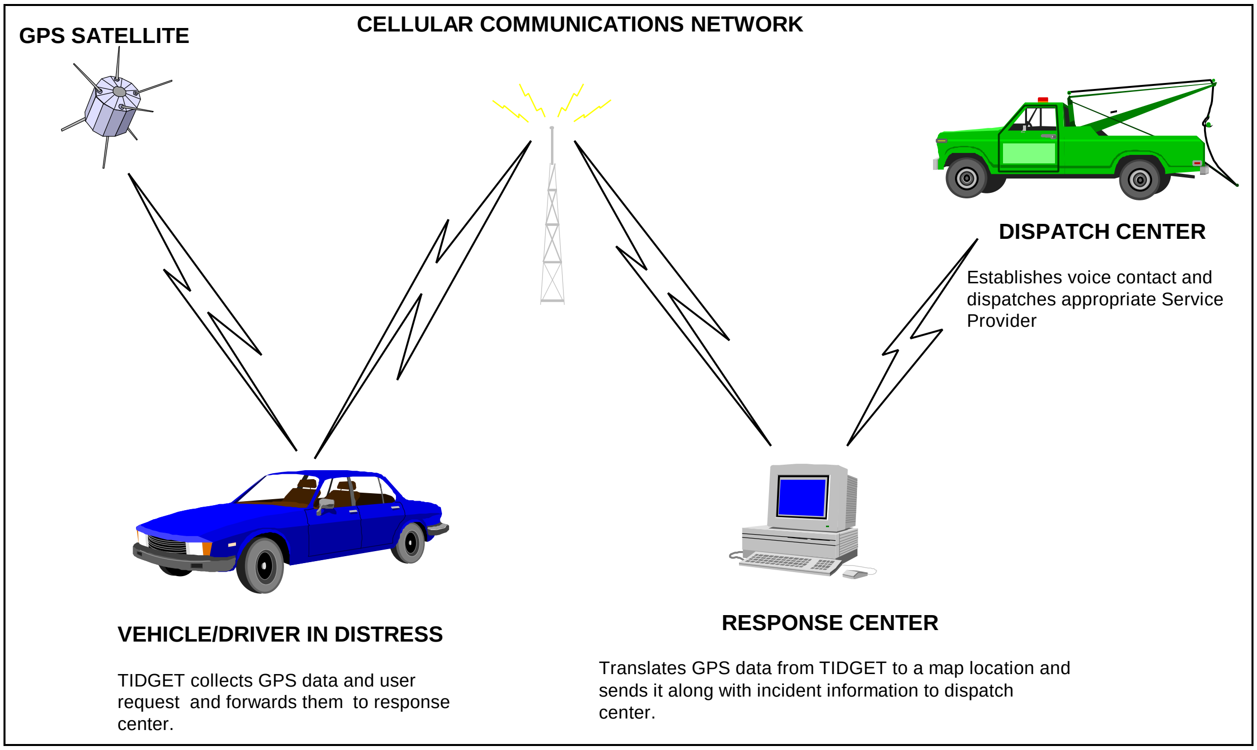


Figure 1: Colorado MAYDAY Conceptual Diagram

The evaluation of Phase I assessed the performance of the prototype units and identified where design changes were required. The Phase I evaluation also examined the human factor issues related to the in-vehicle units and the control center workstations. Phase II assessed the performance and accuracy of the system under varying cellular signal strengths over the proposed geographic test area. Phase III proposed to evaluate the system usability and acceptance, system marketability, and technical performance.

Test Status

The project's independent evaluator prepared evaluation summary reports for Phases I and II.

In Phase I, the evaluator made several conclusions and recommendations. In areas with favorable cellular coverage, the system can calculate a vehicle position that is sufficiently accurate for the system's purpose (averaging within 82 meters). In areas of marginal cellular coverage, the system could often achieve an approximate position and could warn the dispatcher that voice confirmation was needed. When the system could not determine a position, it would default to voice-only mode, ensuring that traditional methods could still be used. The evaluator recommended that the dispatch center support the ability to receive and process multiple, simultaneous incoming calls. The evaluator also observed that system developers needed to address the critical issues of slow system speed, erratic reliability, poor user friendliness, better digital maps, receiving too much information, and better training. The evaluator also recommended testing alternate GPS technologies and developing closer partnerships with other projects testing similar technologies.

The evaluation report for Phase II presented results for each of the evaluation areas. The test participants rated the usability of the system through a survey prepared by the evaluator. These participants found the system easy to use and the buttons and messages understandable. The participants rated the ease of use of the MAYDAY system under a variety of incident scenarios. They responded that the system would be difficult or very difficult to use in incidents in which they would be seriously injured. The system would be easy to very easy to use in situations where they would require assistance or would observe another vehicle that needed assistance. The participants observed that the system took too long (from three to four minutes) before the call went to "voice mode." The participants also responded with their perceptions of the reliability of the system by observing that they were occasionally unable to conduct a test because the system malfunctioned.

The evaluator assessed the marketability of the Colorado MAYDAY system by convening two focus groups. The results of the focus groups led to the conclusion that the potential of the system is promising. The groups identified several critical issues that need to be addressed in terms of consumer acceptance, product features, and market factors. Much of the interest in the system as a product is related to its use as a safety device (for example, in violence or car jacking). In these situations, the focus groups were concerned that the system lacked the ability to communicate quickly and unobtrusively. The focus group participants were concerned about the reliability of the system in key situations (for example, rural or mountain driving). The participants also viewed as important the ability to have automatic and remote activation of the device and to have a cancellation switch. The results of the focus groups show that market acceptance of the concept is very high and participants have a good level of interest in purchasing the system. The primary barriers are the newness of the technology, its credibility, and its questionable reliability in certain situations. The participants felt that a purchase price of $150 and a monthly fee of $20 to $25 would be reasonable.

The independent evaluator assessed the technical performance of the system during Phase II. During the testing, the contractor made improvement to the software that computed the vehicle's position. With the improved software, the system was able to locate the test vehicle to within 100 meters of its actual position in 44 percent of the trials that produced a valid solution. The system was able to locate the vehicle to between 100 and 200 meters of its actual position in 14 percent of the valid trials. In 10 percent of the valid trials the positional difference was greater than 200 meters. The remaining 34 percent of the trials were attributed to non-connection and errors in the cellular links. The cellular communications coverage was strong and reliable in densely populated counties in the test area (where approximately 90 percent of the state's population resides). In areas of marginal to non-existent cellular coverage, the analog cellular system was unreliable in transmitting data. Test participants expressed a desire to have a better verification system o f the progress of the communication during a call.

The evaluator identified several problems with the map display system and the map database used in the system. The speed of the computer used for the map display system was adequate for the test but might be too slow under real world conditions of multiple, simultaneous mayday calls. The display system needs to be enhanced to automatically display streets in the vicinity of the incident. The display system also needs the capability to display more than one incident at a time. The map databases and display should include all roads and road labels, geographic landmarks and bodies of water, and city, county, state and dispatch region boundaries.

Test partners made a decision not to proceed with Phase III due to the inability to negotiate an agreement with a public agency to receive the calls.

Test Partners

AT&T Wireless, Inc.

Colorado Department of Transportation

ESRI

Federal Highway Administration

NAVSYS Corporation

The ENTERPRISE Group (Departments of Transportation from the states of Arizona, Colorado, Iowa, Michigan, Minnesota, North Carolina, and Washington, plus Maricopa County, Arizona, Dutch Ministry of Transport, Ministry of Transport Ontario, and Transport Canada)

References

Castle Rock Consultants, MAYDAY Operational Test Project, Phase I Evaluation Summary Report (Draft), November 1995

Castle Rock Consultants, MAYDAY Operational Test Project, Phase II Evaluation Summary Report (Draft), October 1997

ITS Operational Test Summary
CRESCENT

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202)366-0950

Introduction

The Crescent Project was the demonstration phase of the Heavy Vehicle Electronic License Plate (HELP) program. This project was the first major ITS initiative in the U.S. in the commercial vehicle operations (CVO) field. Conceived in 1983, HELP was a multi-state, international, and public/private research project to design and test integrated technical solutions to problems of CVO roadside enforcement, administration, and operational management. The Crescent system integrated the use of Automatic Vehicle Identification (AVI), automatic Vehicle Classification (AVC), Weigh-In-Motion (WIM), and electronic data communication technologies to electronically screen commercial motor vehicles.

The Program helped state, motor carrier industry, and ITS system and services provider participants to determine the benefits and obstacles of HELP services through real-world experience. The HELP program evolved over time, adding to developing, and refining the services conceived at its inception. The resulting objective of the Crescent Project was to enable a legal truck to drive along the entire project roadway network without having to stop at weigh stations or ports of entry.

The operational testing phase began in 1991 and finished in September 1993.

Project Description

Crescent established approximately 40 specially equipped weigh station and port of entry sites along a corridor from British Columbia south along I-5 through California, then east along I-10 to Texas, and branching onto I-20 (hence the name Crescent). A central computer processed the vehicle information gathered from transponder-equipped trucks using the WIM, AVI, and AVC technologies. Trucks that were properly identified and within legal weight limits were allowed to bypass the test sites.

Figure 1 presents a schematic view of the information included in the Crescent test.

The Crescent project evaluation was comprised of the five test areas:

- <u>On site Analusis of HELP Technologies and Operations</u> - Primary source of data on the performance of individual system components and performance of the integrated system
- <u>State Agency Case Study</u> - Primary source of data on institutional issues affecting implementation and performance
- <u>Motor carrier Case Study</u> - Primary source of data on industry acceptance issues affecting implementation and performance

- Crescent Computer System Components - Primary source of data on the computer platform that integrates the other technologies into systems that provide CVO services
- Crescent Demonstration Office - Primary source of data on the operations of the central "service provider" responsible for data input, processing, and distribution for the HELP applications tested

The information gathered and lessons learned during the conduct of the test were compiled by the evaluation team. The team identified six potential CVO service categories and integrated the test results to draw conclusions about particular CVO services. The evaluation team judged each service category using measures that included benefits to industry, institutional support and/or barriers, industry support and/or barriers, and technical feasibility and development.

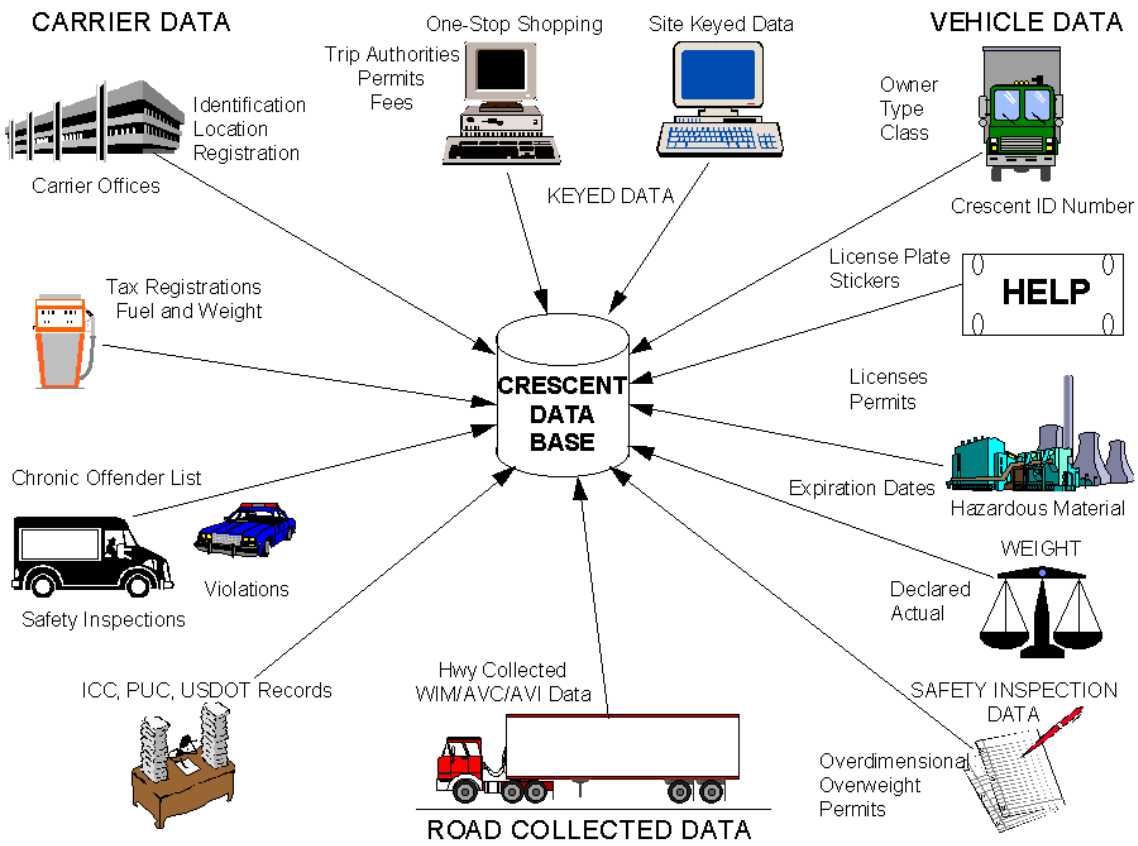


Figure 1: Crescent Information

Results

The evaluator's conclusions may be summarized in several broad statements that convey the most important results. Generally, HELP technologies and procedures performed adequately and were not a barrier to deployment. The greatest obstacles to the feasibility and effectiveness of CVO services are institutional issues. Some of these issues are government policies that prevent electronic data collection and sharing, lack of commitment by senior state government management, and a lack of training and resources for state employees who operate the system. State agency through architecture and standards development.

Conclusions for the six potential CVO service categories as identified by the evaluation team are as follows:

- Roadside dimension and weight compliance clearance - This service was found to be the closest to being ready for deployment. It offers benefits from improved road safety, more efficient enforcement, reduced emission, and reduced weigh station stops. It has the fewest institutional and industry barriers, and technologically it was successfully demonstrated
- Pre-clearance of vehicles with proper documents - This service was also a highly leveraged CVO service and was seen as a priority area for refinement and deployment. It may provide high benefits to both states and carriers and could be accomplished with available technologies. It has somewhat higher institutional barriers to overcome than other preclearance services
- Government planning - This service was the third highly leveraged CVO service and was also identified as a priority area for refinement and deployment. It could provide benefits to states through better and more timely road use data, could be accomplished at low additional cost with available technologies, and has almost no institutional barriers to overcome
- Government audits of carrier records - This service could improve the accuracy and reduce costs of state audits, but has little leverage. Benefits accrue only to states, while significant institutional and industry barriers exist. Automated safety inspection audits were considered before other audit areas.
- Government processing of CVO documents - This service is important in order for other services to be effective and could also improve the effective and could also improve the efficiency of the credentialling process. However, it faces high institutional barriers
- Industry administration of divers and vehicles - This service faces no institutional barriers, few industry barriers, but provides relatively minor industry benefits. Other systems are likely to better support this service.

Legacy

HELP, Inc., a not for profit corporation, was concluding. It currently offers PrePass, a weigh station by-pass service in California and other western states. HELP, Inc. is also involved in subsequent operational tests including the Commercial Vehicle Operations One-Stop Electronic Purchasing and Processing Operational Test (HELP One-Stop).

Test Partners

Castle Rock Consultants
Federal Highway Administration (FHWA)
International Road Dynamics Inc.

Lockheed Integrated Systems Company
State DOTs from California, Washington, Oregon, Arizona, New Mexico and Texas
Western Highway Institute / ATA Foundation
WHM Transportation Engineering Consultants, Inc.

References

The Crescent Evaluation Team. The Crescent Project: An Evaluation of an Element of the HELP Program, Executive Summary, February 1994

ITS Field Operational Test Summary

Driver Information Radio using Experimental Communication Technologies (DIRECT)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Driver Information Radio Experimenting with Communication Technology (DIRECT) ITS Field Operational Test is deploying and evaluating several alternative low-cost methods of communicating travel information to motorists in the Detroit, Michigan metropolitan area. The system sends travel information to a group of test vehicles and then tracks the vehicles during their commute. The tracking information will be analyzed to understand actual traveler behavior and the modifications travelers make based on improved knowledge.

The field evaluation phase of the test began in April of 1996 and concluded in December 1997.

Project Description

DIRECT is deploying and evaluating four methods of providing real-time traffic information. The test uses existing technology systems that will eventually be accessible to all drivers. The test will compare the four systems in terms of travel benefits, technical performance, projected costs, driver distraction and safety, and associated institutional issues. Recruited drivers use the systems during their normal commute and provide feedback to the evaluators. Test evaluators compare the four systems as the drivers travel along the same two corridors.

The first phase is a limited deployment that is gathering data from a small set of recruited drivers. This limited deployment will determine which methods are most feasible and cost-beneficial from the public agency and individual user perspectives. Considering the results of the initial phase, test personnel plan an expanded second phase using the most attractive technologies. The long-range goal is to promote widespread use of Advanced Traveler Information System (ATIS) in Southeast Michigan.

To achieve the project goals, the test equipped a group of vehicles with different communications methods to receive travel information. The methods include Radio Data Broadcast System (RDBS), FM subcarrier, Automatic Highway Advisory Radio (AHAR), Low-Power Highway Advisory Radio (LPHAR) and cellular phones. Initial experimental testing includes 30 equipped vehicles. The test vehicles are equipped with Automatic Vehicle Location devices (AVLs) that track their location. Analysis of the tracking data will provide further insight into traveler responses.

As part of the test, the Michigan Intelligent Transportation Systems Center (MITSC) established and maintained a traffic information messaging service. The MITSC collects traffic information from a variety of sources and composes messages about incidents, congestion, and weather conditions. The MITSC transmits these messages by one of the three broadcast technologies (LPHAR, AHAR, and RDBS) and makes them available on the cellular phone message menu. The system alerts participating drivers to available broadcast messages either via receiving equipment in the vehicle or beacons located near the transmitters. Cellular phone participants can call an automated, menu-driven messaging service to receive updated information. The vehicle tracking system records and stores the movement (and, hence, the reaction to messages) of participating drivers. Figure 1 presents a schematic of the components and interfaces of the system.

The test also publicized the availability of the traffic information to the general public. General public travelers can access several of the technologies without special equipment. Both the LPHAR and the AHAR broadcast messages that motorists can receive on their car radios. Members of the public that have a cellular telephone can call for specific traffic information. Up to 1,000 general public users were expected to participate. Evaluators are surveying a portion of those users to help complete the evaluation.

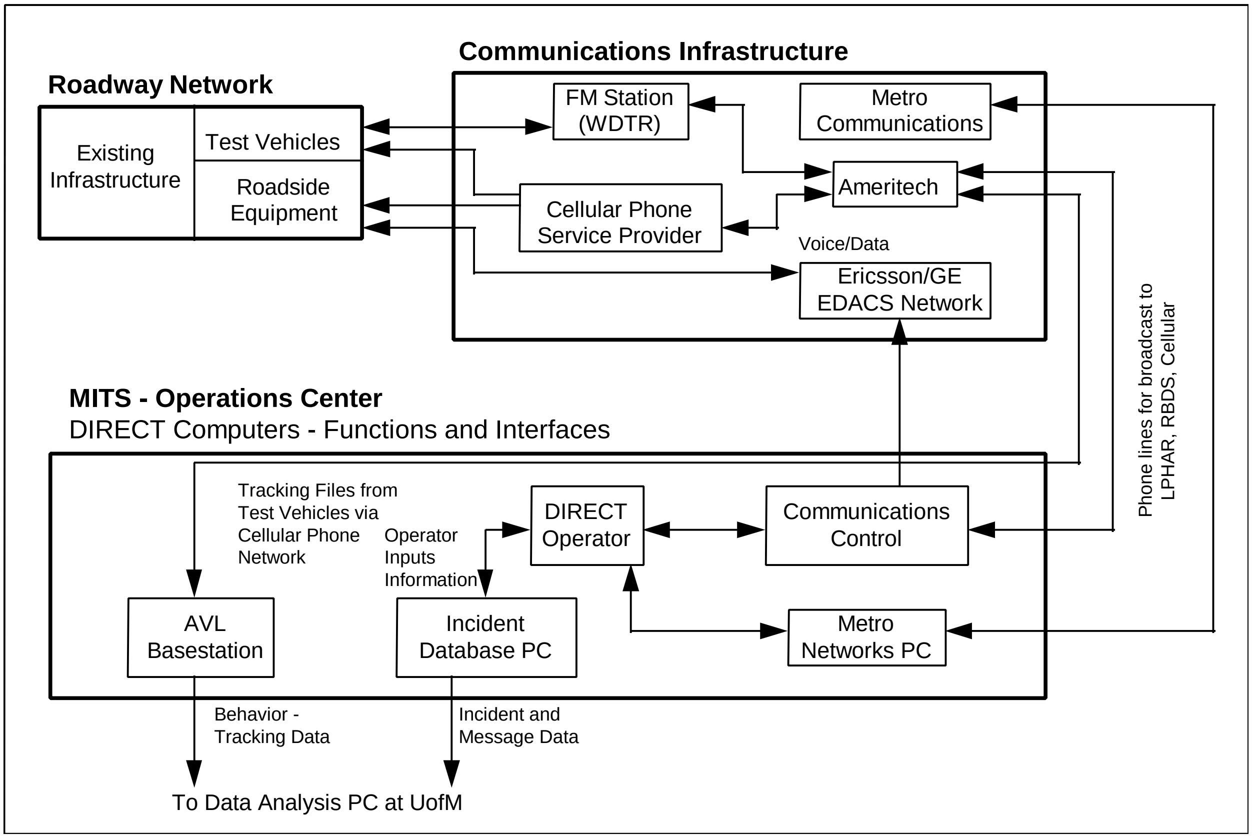


Figure 1: DIRECT System Components and Interfaces

The evaluation focuses on five functional areas:

- Natural Use (user behavior changes, attitudes, and opinions after using the system)
- Simulation and Modeling (forecast impacts and benefits of higher levels of market penetration)
- Human Factors (driver attention, ease of use, and safety of alternative presentation methods)
- Technical Performance and Cost (performance and reliability, likely production cost of systems)

- Institutional Issues (institutional problems encountered, solutions, and lessons learned).

The evaluation focuses on user attitudes, preferences and projected system-level effects. In addition to the four tested systems, the evaluation will compare benefits from a conventional AM-FM broadcast reporting system to baseline measurements. The test area includes some changeable message signs as part of the baseline.

Test Status

Data collection concluded in December 1997. The Final Evaluation Report for Phase I is anticipated in April 1998 but interim results are available. Although the reader must use caution interpreting them because the study is incomplete, interim results (as of July 1997) indicate that:

- Drivers want specific types of traffic information such as unexpected delays, location of incidents, length of present delay, expected time for incident to clear, location of construction activity, advice on whether to divert, and alternate routes. Drivers prefer information specific to the area in which they plan to travel (as opposed to information for the entire metro area).
- Drivers found all four technologies easy to use.
- The technologies involving extensive field components (LPHAR, AHAR, RDBS), were difficult to maintain and, therefore, less reliable.
- Drivers did not feel that the DIRECT system they used was a significant improvement over commercial radio traffic information. They did think, however, that DIRECT systems were an improvement over television traffic information and changeable message signs.
- Those drivers surveyed reported, on average, having changed their route only one time in the eight week test period due to information they received from the DIRECT systems.

Test Partners

AAA of Michigan

Capstone/Ameritech

Delco

Ericsson/GE

ERIM

Federal Highway Administration

Ford Motor Company

General Motors

Metro Networks

Michigan Emergency Patrol

Michigan State Police

WDTR FM Radio

References

DIRECT Interim Results (7/30/97), University of Michigan Intelligent Transportation Systems Research Lab, July, 1997

ITS Operational Test Summary
During Incidents Vehicles Exit to Reduce Time

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The During Incidents Vehicles Exit to Reduce Time (DIVERT) ITS Field Operational Test was previously named the St. Paul Incident Management. Minnesota Guidestar, Minnesota Department of Transportation's ITS project, conceived the test to demonstrate the feasibility and effectiveness of diverting freeway traffic onto pre-planned diversion routes along surface streets during freeway incidents. The specific goals of the project include:

- Improving traffic flow management
- Applying new technologies
- Improving institutional interaction and cooperation.

The project encompasses the I-94/I-35E 'Common Section' and parallel streets within the Central Business District (CBD) of St. Paul, Minnesota. Figure 1 shows the project location. The test became operational in December 1996. Originally planned for completion in December 1997, the test has been extended for nine months to provide a longer evaluation period. The final evaluation report is expected in September 1998.

Project Description

The DIVERT field operational test provides traffic guidance and control during freeway incidents. If a major incident occurs on the test freeway section, traffic managers will divert traffic to arterial bypass routes. Traffic managers will control the flow using specially designed surveillance and guidance equipment and coordinated signal timing plans. Under this controlled diversion, managers add and accommodate the diverted traffic to the surface streets in a planned fashion, rather than having traffic randomly entering the St. Paul CBD in an uncontrolled fashion. The project area includes the tested freeway section, arterial diversion routes, and applicable signalized intersections and entrance ramps. Figure 1 shows the general location of the project.

The project serves as a trial for assessing the effectiveness of several technologies. The test applies these technologies to augment freeway capacity by alerting motorists to alternate travel routes. The test then monitors network performance during major freeway incidents.

The DIVERT project components include:

- Existing freeway changeable message signs
- Cellular telephone-based portable changeable message signs positioned prior to freeway exit ramps to serve as a traveler notification system
- Unique fiber-optic based blank-out signs, activated only during incident diversions, to guide motorists along the diversion routes and minimize confusion or conflict with the existing static signs

- Static trailblazer signs to designate diversion routes
- A surveillance camera system including video feed from the traffic management system
- Existing inductive loops along the freeway system
- Traffic responsive operations incorporating pre-developed, incident-based timing plans.

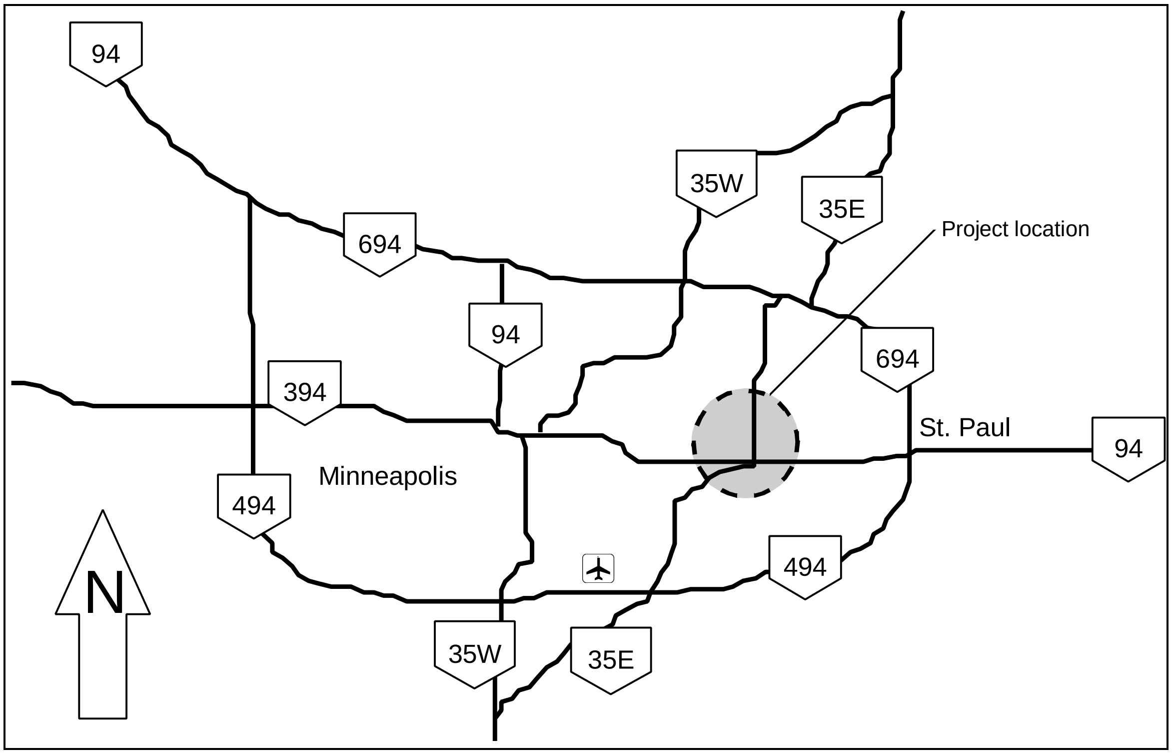


Figure 1: General Project Location

The test collects real-time traffic flow data (volume, occupancy, and speed) from inductive loops strategically located along the freeway system. Software-based algorithms use this data to detect “congestion.” When the system detects a congestion condition, it alerts the DIVERT operator through a paging system. The operator visually verifies traffic conditions on both the freeway and the proposed diversion routes using a CCTV surveillance system. The operator decides if a traffic diversion is required and feasible depending on the level of congestion along the diverted routes. If warranted, the operator deploys appropriate traveler information and traffic flow management strategies. The operator continues to monitor system operation and network flow conditions as the basis for selecting next steps.

In addition to notifying motorists of incident conditions and “bypass” opportunities, DIVERT adjusts the timing plans of traffic signals along the diversion routes. DIVERT's adjustment of the signal timing plans optimizes the capacity of the diversion routes while not unduly penalizing other traffic movements. As part of the DIVERT development process, traffic managers conducted a limited sensitivity analysis of the arterial network. This analysis indicated that accommodating the diverted traffic through the diversion routes would be feasible.

The evaluation of the test focuses on various aspects of the DIVERT system including the system architecture, surveillance system, communication system, control system, system benefits, system cost, user satisfaction, system transferability, and institutional and legal issues.

Test Status

The test is currently operational. Test personnel are collecting evaluation data. An extension of the test was deemed necessary since geometric improvements on the test freeway section have minimized the frequency of major incidents requiring traffic diversion.

Test Partners

Federal Highway Administration

Minnesota Department of Transportation

City of St. Paul

Safetran Traffic Systems, Inc.

References

None published.

ITS Operational Test Summary

Dynamic Downhill Truck Speed Warning System

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Dynamic Downhill Truck Speed Warning System (DTSW) ITS Field Operational Test is a Commercial Vehicle Operations test that evaluates a driver advisory system for long, steep downgrades. The system operates by automatically weighing and classifying trucks as they approach a long downhill section of highway. Considering the weight and class of the truck, the system calculates a safe descent speed. Each truck receives a vehicle-specific, recommended safe speed message on a variable message sign. The project seeks to affect commercial vehicle driver behavior by providing vehicle-specific, safe downhill speed messages.

The system began operation in mid-1995 on Interstate 70 west of the Eisenhower Tunnel in Colorado. Beginning July 1997 the system was reconstructed and relocated inside the Eisenhower Tunnel just before the tunnel exit. During and after reconstruction baseline truck speed data was collected for use in the evaluation.

Project Description

The Colorado Department of Transportation proposed the “Dynamic Truck Speed Warning System for Long Downgrades” in October 1992. Their proposal cited several disturbing statistics about past truck accidents on steep downgrades on Colorado highways. These statistics established the need to demonstrate existing technology that might reduce the frequency and severity of downgrade truck accidents.

The DTSW system consists of inductive loops that trigger the weigh in motion (WIM) sensors, variable message signs (VMS), and computer hardware and software. Figure 1 presents a schematic of the DTSW system components. The system identifies commercial vehicles and determines their weight, classification and speed. Using a Federal Highway Administration algorithm, the system calculates a recommended speed and presents it to the driver on a VMS. It is hoped that the drivers will heed the speed warning. Following the recommended speed would reduce or prevent runaway truck accidents or use of the two runaway truck ramps farther down the 7 percent grade.

The VMS displaying the advised speed is 250 feet beyond the loop detectors and WIM strips. Thus, a trucker traveling 40 mph (posted truck speed is 30 mph) has about 4 seconds to read the speed message. The DTSW system is positioned at the top of the grade inside the tunnel so that truckers receive the advice before building up speed on the downgrade. A second set of loop detectors and WIM strips are located on the downgrade 1.5 miles beyond the tunnel exit. Both sets of loops and WIM strips record each vehicle’s time of passage, configuration, speed and weight. This information is generally sufficient to identify each truck and cross-reference the data from both stations.

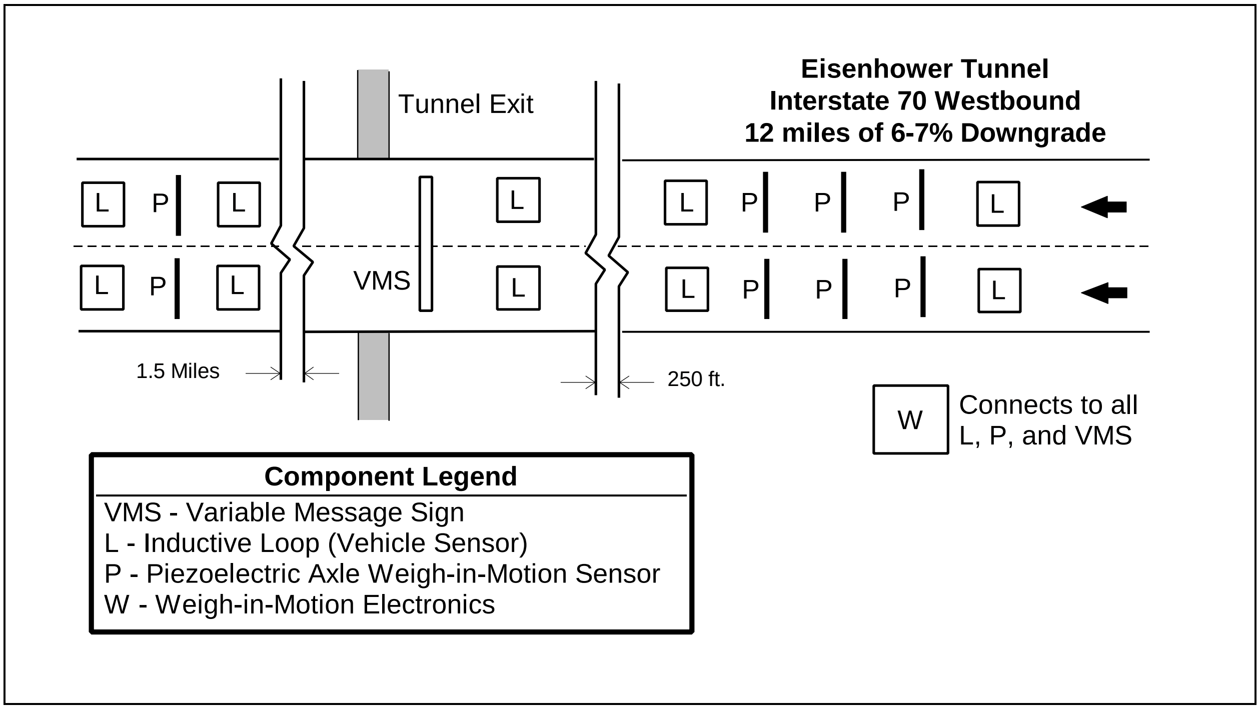


Figure 1: Schematic of DTSW System

The evaluation of the system focuses on two principal areas of concern, technical performance and driver impact. The technical performance evaluation will assess the accuracy of the system in measuring truck weight, speed, and type and the reliability of the system in providing the correct message to the correct truck. This evaluation will also assess the durability of the system as determined by system downtime during the study period. Driver impacts will assess driver awareness, based on driver interviews, and driver compliance, based on speeds measured at the tunnel exit and 1.5 miles downhill.

Test Status

In conjunction with a highway repaving project, the entire DTSW system was relocated from a position just outside the Eisenhower Tunnel to just inside it. Reinstallation was completed December 1997. An evaluation report is expected May 1998.

Test Partners

Colorado Department of Transportation

Colorado Department of Public Safety

Federal Highway Administration

University of Colorado at Denver

International Road Dynamics.

References

None published.

ITS Operational Test Summary

Electronic Processing at International Crossings

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Electronic Processing at International Crossings (EPIC) ITS Field Operational Test demonstrates an electronic clearance system to accelerate the crossing of commercial vehicles through the US-Mexican border. The primary goal of the EPIC Field Operational Test is to demonstrate the potential to increase productivity to motor carriers and state administrators by automating and integrating some administrative functions. These administrative functions include vehicle registration, safety, fee payment, tax and insurance compliance, and trip permit issuance. The system will electronically detect participating vehicles and notify regulatory agencies. The regulatory agency will provide an electronic clearance and notification of clearance status to the driver through a transponder mounted inside the windshield of the vehicle. Cleared vehicles may proceed to their destination without additional delays for credential, vehicle or driver verification.

The test takes place at the US-Mexican border in Nogales, AZ. Test operations began in November 1996 and will conclude in May 1998. The final evaluation report is expected in early August 1998.

Project Description

The EPIC Field Operational Test demonstrates and tests the capability of a linked electronic system to more efficiently process motor carriers through international border crossings. The system consists of dedicated short-range communications (DSRC) and other automated electronic components. The system aims to increase productivity for motor carriers and state administrators. The EPIC concept will benefit motor carriers and state agencies by creating an information management solution. This solution efficiently links each independent processing step though an Internet-based operations platform. This platform makes the information accessible to those who need it within the transportation industry. Regulatory agencies contribute to this information via a secure, agency accessible network.

The main objectives of the test are to:

- Establish methods for reducing impacts of institutional and legal barriers to processing commercial motor vehicles through international border crossings
- Utilize electronic vehicle, carrier, and driver information necessary to meet regulatory needs
- Integrate existing regulatory agency information databases
- Provide electronic trip information and verify the commercial driver's license (CDL) of the vehicle operator.

The technologies demonstrated in this test and their respective functions include:

- Internet link to transmit information for pre-trip processing and clearance functions

- RF (radio frequency) vehicle to roadside communications, also known as dedicated short range communications systems (DSRC), to identify the vehicle and communicate with the driver
- Electronic photographs to enhance the driver clearance process for CDL and safety purposes used by the Arizona Department of Transportation and Department of Public Safety.
- Traffic management and control systems to minimize average processing times for northbound movements and to monitor border traffic congestion and conditions.

The system operates under real world conditions with 5 motor carriers participating in the test. Three of the five carriers that are actively participating have a total of seven trucks currently equipped with transponders. These trucks make commercial movements into the US at Nogales. The test monitors the time it takes each movement to cross the immediate area of the border zone and the efficiency with which the Arizona Department of Transportation (ADOT) processes each movement. The test also monitors and will evaluate the usefulness of the Internet clearance status process. Figure shows a schematic of the EPIC System.

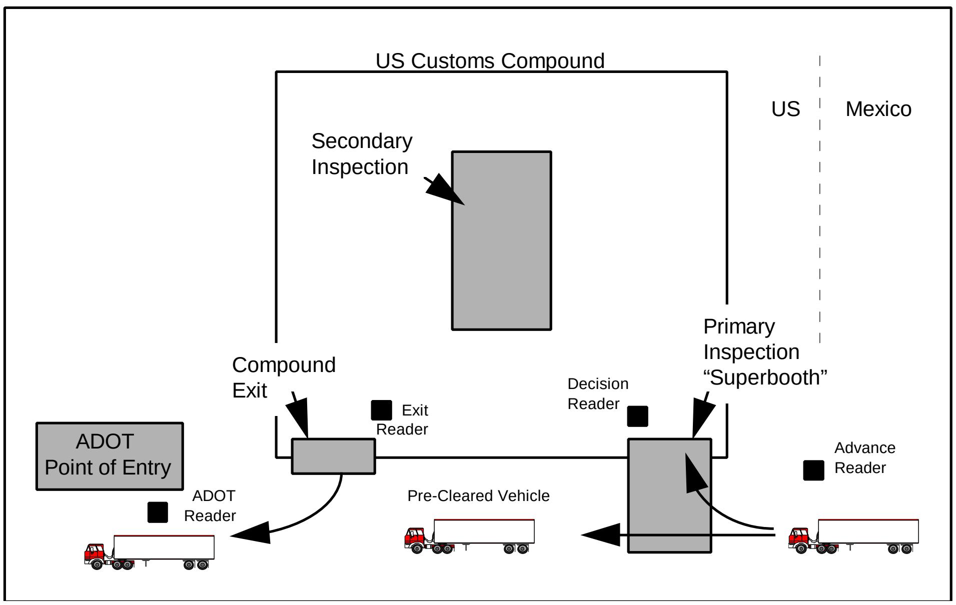


Figure 1: EPIC System Overview

The test's primary evaluation goals are to assess system effectiveness, evaluate system operation, determine physical requirements, evaluate user acceptance, and assess institutional issues.

Test Status

The test is currently in operation and is processing trucks from the three participating motor carriers. The physical layout of the customs compound where the test is being conducted has undergone several changes during the last half of 1997. One change is the installation of an elevated customs inspector booth and a Customs compound by-pass lane. Customs and ADOT officials staff the new booth, called a "Superbooth." About one-third of the trucks crossing the border proceed through the Superbooth lane. From this lane, the trucks by-pass the main compound and proceed directly to the weigh scales. The inspectors send those trucks without proper credentials or those suspected of other infractions back to the compound for more thorough inspection. The Superbooth lane is equipped with a transponder reader and an EPIC processing computer. Test personnel will gather data at this lane in addition to the previously equipped lanes and other locations at the compound.

Evaluators are gathering baseline data. This data includes current cycle times for trucks crossing the border. The data also includes movement and credentialing information collected electronically from transponder equipped trucks through the customs compound traffic control system. The final evaluation report is expected in early August 1998.

Test Partners

American Trucking Associations Foundation

Arizona Department of Transportation (ADOT)

Federal Highway Administration

HELP Inc.

Hughes TMS

Lockheed Martin IMS

PB Farradyne

References

The EPIC Field Operational Test web site: http://www.epic-ibc.com/

No currently published reports, articles, or papers.

ITS Field Operational Test Summary

Evaluating Environmental Impacts of ITS Using LIDAR Technology

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

This ITS Field Operational Test demonstrated and evaluated the use of Light Detection And Ranging (LIDAR) technology in monitoring air quality. LIDAR technology operates in a manner similar to radar, except that the emitted signal is a laser beam rather than a radio wave. A reflected LIDAR signal occurs when a pulsed laser beam scatters off aerosol particles in the atmosphere, analogous to radar signals being reflected and scattered off rain droplets to produce the familiar Doppler radar weather images. Test personnel conducted four separate tests of the LIDAR system in urban and suburban locations in Minnesota under varying weather conditions from July to November 1994.

Project Description

Test personnel installed the LIDAR system and a group of air quality monitoring devices at public events expected to produce significant amounts of traffic and, consequently, pollution. Figure 1 is an illustration of the LIDAR application for air quality measurement. The LIDAR equipment scanned the area above the expected traffic flow. Test personnel placed the air quality monitoring devices in the path of the LIDAR beam near the location of the expected traffic flow.

The LIDAR system sends out pulses of laser light in a known direction. The light scatters off particles in the beam's path. Suspended aerosol particles in the beam's path reflect some of the light to the instrument. The equipment collects the reflection using a telescope and focuses it onto a sensitive photodetector. The system resolves the spatial distribution of particles by measuring the time it takes for the scattered light to reach the detector. The system can produce two- and three-dimensional maps of the reflected signal by scanning the laser through a sequence of angles.

Test personnel installed the LIDAR system on a platform approximately six meters above the ground and aligned the LIDAR beam to scan the area above the expected traffic flow. [The LIDAR beam is not considered "eye safe" in the first two kilometers of travel and, therefore, had to be elevated for safety reasons.] Elevating the LIDAR system also provided an unobstructed line-of-sight to the air quality monitoring equipment.

Test personnel installed a group of air quality monitoring devices (particulate size distribution, carbon monoxide (CO), and weather) on another platform approximately eight meters in the air. This second platform was directly in the alignment of the LIDAR and close to the expected traffic flow. The group of monitoring devices independently measured air quality indicators for comparison to the readings obtained by the LIDAR equipment. Test personnel set up traffic counters at several locations in the traffic flow.

As traffic from the event exited and dispersed, the LIDAR and the monitoring devices measured the concentration of pollutants in the air. The LIDAR system acquired sequences of single point time histories of the reflected signals coming from the air entering the platform mounted monitoring devices. The LIDAR system interspersed these single point sequences with two- and three-dimensional scans over the access routes of the events. The single point measurements provided the means to establish correlation between the LIDAR signal and the measurements of the conventional monitoring devices. The equipment typically recorded these measurements as three-minute histories. The two-dimensional scans were useful in developing and validating models and typically required two minutes to obtain. The three-dimensional scans were useful in monitoring developments over an entire region and required 10 to 15 minutes to obtain.

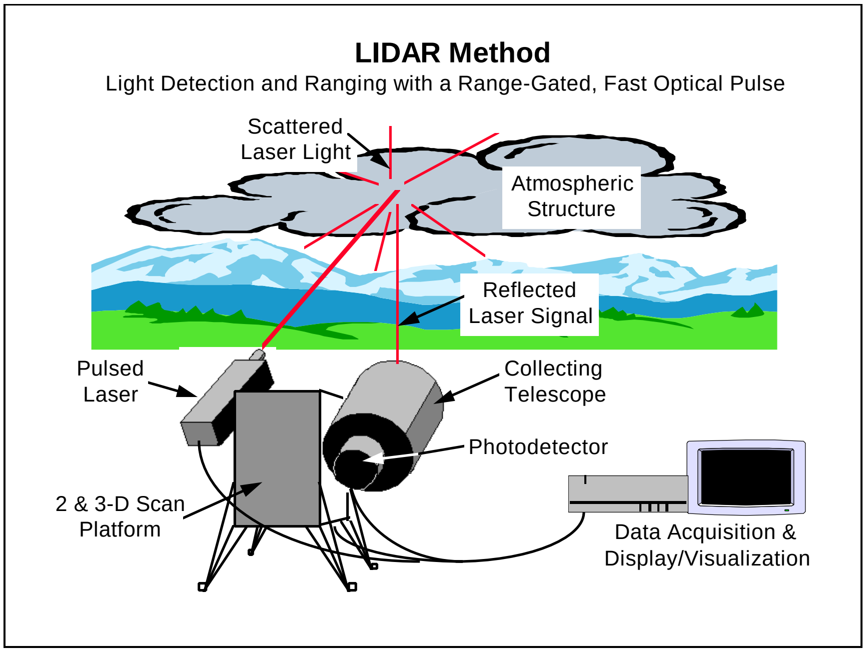


Figure 1: LIDAR System Application for Air Quality Measurement

In addition to the direct air quality measurement tests, the LIDAR test plan also attempted to evaluate the use of a portable traffic management system (PTMS). Test personnel re-routed traffic exiting from public events using portable variable message signs. Test personnel then used the real-time LIDAR pollution data to gauge the effects of the PTMS rerouting. Test personnel used the LIDAR system to monitor whether the PTMS-directed changes in the traffic conditions in a local area brought about significant reductions in pollutant concentrations or merely shifted the problem to a different location.

Results

Test personnel were able to answer many questions regarding the usefulness of the LIDAR technology in pollution measurement, but were not able to collect sufficient data to analyze the impact of the PTMS.

Test personnel concluded that the LIDAR system could be used as a quantitative indication of particle concentrations with certain important restrictions. To be useful in this context, the size of the particles to be measured must be on the same order as the wavelength of the laser employed. Test personnel must also make auxiliary measurements of the size distribution to rule out the possibility of abnormal size distributions or changes in particle composition. The system, however, probably cannot be used as a quantitative measurement tool because of the uncertainties associated with particle size and composition. In other words, the LIDAR system can tell what kind of particulates are suspended but cannot reliably measure the amount of pollution.

Test personnel also concluded that the LIDAR system could only be viewed as an indirect, qualitative indicator of CO levels, and then only under certain circumstances. The system could be used to identify roadway-generated CO plumes that were likely to exceed allowable levels. Qualitative measurements of CO, however, would require the use of more sophisticated LIDAR systems tuned to measure CO concentrations more directly.

Additionally:

- The system can measure concentrations of particles whose sizes are on the same order of magnitude as the wavelength of the laser employed. Concentrations of particles much smaller or larger than the wavelength of the laser, however, may make up a significant portion of the suspended matter in the air. Testers concluded that any deployment of LIDAR technology must also include auxiliary measurements of the particle size distribution to rule out the possibilities of abnormal size distributions or changes in particle composition.

- Test personnel observed that the system requires several trained operators to set up and oversee the operation. They also lamented the lack of real-time data display. Test personnel had to convert all data to a common format and to enter it into a single program in order to produce correlated maps and images. Complete results of the test, therefore, were not available for several months. Once all of the information (from LIDAR, the monitoring devices, and a GIS database) were converted and combined, personnel were able to produce quantitative maps and other exhibits of aerosol concentrations. These maps were understandable with a minimum of study.

The system is easily portable and reasonably reliable, but encountered several problems in the field:

- The test laser beam was not considered "eye-safe" in the first two kilometers of travel. Test personnel, therefore, had to ensure that they did not aim the LIDAR at the street level. They also had to assure that a laser safety officer was present during the tests.

- Cold weather (at or below freezing - 0^0C) posed some difficulties for the equipment. The LIDAR device became inoperable at these temperatures until test personnel moved the equipment to a more protected location and warmed it. The particle sensors on the monitoring platform also had to be sheltered and warmed.

The test was unable to gather sufficient data to evaluate the PTMS. Some of the originally scheduled events either did not take place or were much smaller than expected. Therefore, test personnel chose alternative events and took measurements at these events. Unfortunately, the variations in site conditions and weather made it impossible to collect enough data under similar conditions to assess the pollution mitigating effects of the PTMS.

Test personnel recommended several possible uses and improvements for the LIDAR system and the testing procedures:

- The system has excellent potential for helping to develop and validate pollution source and dispersion models. The data should be available for display in near real-time. Such a display should include a time stamp and the direction heading of the LIDAR beam.

- Future tests should include one or more “calibration” measurements using particle-sizing instruments.
- Any future test should also address the data conversion bottleneck of making all the data available for analysis on a single machine.
- Local air quality personnel or EPA air quality employees should assist with the siting and operation of the pollution sampling equipment.

Legacy

The equipment evaluated in this test was a prototype system. There are no plans to continue the development of this system.

Test Partners

Federal Highway Administration

IBM

Los Alamos National Laboratory

Minnesota Department of Transportation

Santa Fe Technologies

University of Minnesota

References

Chakravarty, S., et al, Wide-Area Remote Sensing of Air Quality Impacts of ITS, March 1995.

Hofeldt, D., Preliminary Summary of Findings of LIDAR Project Evaluation (Draft), University of Minnesota, December 1995.

ITS Operational Test Summary

Faster and Safer Travel Through Traffic Routing and Advanced Controls

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Faster and Safer Travel Through Traffic Routing and Advanced Controls (FAST-TRAC) ITS Field Operational Test integrates Advanced Traffic Management System (ATMS) and Advanced Traveler Information System (ATIS) components in Oakland County, Michigan. FAST-TRAC's purpose is to improve mobility and safety on the increasingly congested arterial roads and freeways of the county. The project intended to combine the ATMS component - the Australian SCATS (Sydney Coordinated Adaptive Traffic System) adaptive traffic signal control - with the ATIS component - the roadside beacon-based Siemens Ali-Scout system.

This massive deployment commenced in 1991. The implementation phase of the FAST-TRAC project will conclude in June 2000. In February 1998, the test partners decided to eliminate the Ali-Scout component but continue implementation of the other components and features. The evaluation of the system is continuing.

Project Description

Implementation of FAST-TRAC began in August 1991 and continues. The system is now fully operational. There are 350 intersections under SCATS control. During the Field Operational Test data collection and analysis period, there were approximately 100 Ali-Scout beacons operating. The County's Traffic Operations Center intended to integrate the ATMS and ATIS components. Figure 1 presents the FAST-TRAC coverage area.

The ATMS component of the system is SCATS. SCATS is a third generation traffic management system. The FAST-TRAC project is the first major SCATS installation in North America. In its adaptive mode, SCATS operates in real time, adjusting traffic signal timing throughout the network in response to variations in traffic demand and system capacity. A voice-grade phone line connects each local traffic signal controller to a regional computer. The regional computer provides strategic control and links system operators and the individual signal controllers. Together, the regional computer and the local controllers comprise an autonomous traffic control system. To manage the entire traffic network, the system adds a central management computer.

The principal purpose of the SCATS system is to minimize overall stops and delays on the network. During congested conditions, the system maximizes roadway capacity and minimizes the possibility of traffic jams by controlling queue formation.

The FAST-TRAC project has one significant departure from other large SCATS installations. In other installations, the system collected real-time traffic data using loop detectors. FAST-TRAC uses the Autoscope video-imaging sensor. The main advantage of using these sensors is their ease of installation compared to the loop detectors. The Autoscope sensors also have reduced maintenance costs.

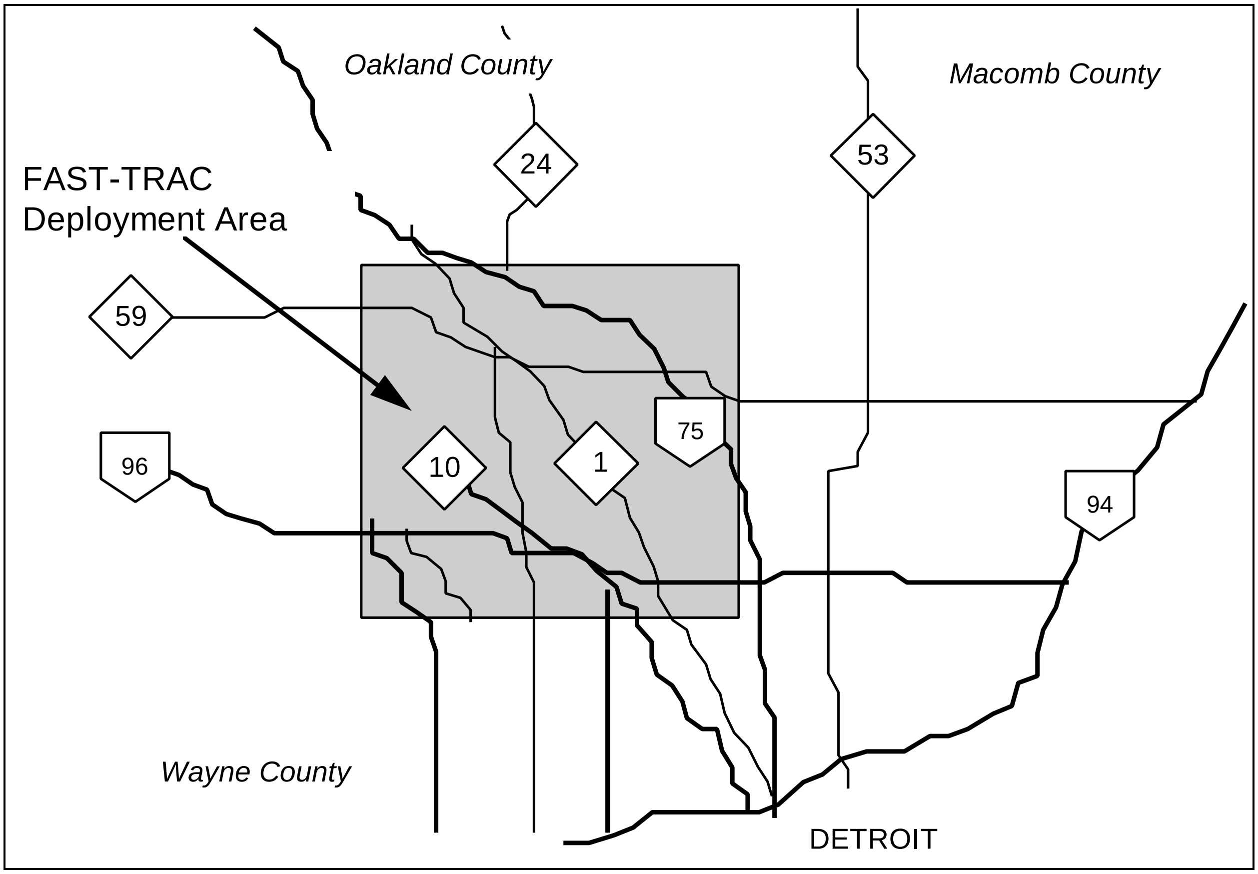


Figure 1: FAST-TRAC Coverage Area

The ATIS component of the system proposed in the original project concept was the Ali-Scout system developed by Siemens. Ali-Scout is a route guidance system that provides dynamic navigation information to motorists. Ali-Scout takes into account link congestion levels that influence travel times on various possible travel routes. Ali-Scout has three major components: a central computer that calculates route guidance information, a network of roadside infrared beacon sites that communicate with the vehicles, and participating vehicles. The participating vehicles are equipped with an on-board navigation processor, infrared communication devices, and a driver interface display.

In operation, drivers enter a destination code into the onboard computer or choose a preprogrammed destination. Using the infrared communication link between the vehicle and the roadside beacons, the Ali-Scout system exchanges traffic and route guidance information. As it travels, the vehicle acts as a traffic probe, gathering travel time, stop times, last beacon identity and vehicle type. When it passes the next roadside beacon, the vehicle transfers this information to the beacon, which forwards it to the central computer.

The vehicle also receives route guidance information from the beacons. This route guidance information includes recommended routes, digitized road maps, and traffic condition information. Inside the vehicle, the driver follows the recommended route guided by a directional arrow on the display. As the vehicle passes each beacon, it receives more network traffic condition data.

Considering this information, the Ali-Scout system provides timely navigational information to the driver using both voice and display commands. Approximately a quarter mile before the destination, the vehicle receives the last navigation information and the driver completes the journey on his or her own.

The Road Commission for Oakland County is the program leader and has overall FAST-TRAC program management responsibility. The Commission coordinates with managers from the other significant partners to set goals and objectives, establish major milestones, and track program progress. Major program elements are organized under committees. Project direction on many aspects is determined by the consensus of members on the committees

Test Status

The FAST-TRAC project completion date is June 2000. The system is operational and is serving Oakland County well. Phase IIB and Phase III (final deployment phase) activities are ongoing. Test personnel conducted an assessment of the dynamic route guidance feature of the Ali-Scout component. During this testing, however, personnel discovered that integrating the Ali-Scout and the SCATS systems was not technically feasible. The evaluator is conducting a “systems integration case study." This study focuses on the lessons learned from the attempted integration. The study also assesses the system’s transferability to other locations in the country.

Test partners decided in February 1998 to eliminate the Ali-Scout component of the test.

Although final results are not available, several interim analyses have been completed. Preliminary studies to determine the effectiveness of the SCATS system were conducted in the spring of 1994. Initial findings indicated:

- **Speeds:** Installation of the system resulted in increases in average speeds of up to 19% on major arterial roads during peak periods and in the peak direction of travel. On lesser arterial roads, during peak periods, the results were less impressive. These less impressive results are primarily a function of SCATS, since it gives priority to major arterial roads. SCATS appeared to handle peak period traffic volumes very well. Analyses indicated, however, that average speeds dropped both immediately before and after peak periods

- **Delays:** At several intersections, average delay decreased on major road approaches but appears to have increased on minor approaches. Nevertheless, total intersection delay decreased at most intersections. This result occurred despite the addition of left turn phases at many of these intersections

- **Accidents:** Analysis of traffic accidents at nine intersections (where left turn phasing was installed in conjunction with SCATS) showed mixed results. Total accident frequency increased by 27% after the system was implemented. Left turn accidents, however, decreased from 27 in the ‘before’ period to only 3 in the ‘after’ period. This 89% reduction was mostly attributed to the installation of the leading-protected left turn phases at these intersections.

- **Responsiveness:** In addition to the mobility and safety benefits realized, a significant benefit of installing the system has been the flexibility it provides traffic managers to respond to changes in traffic flow, local policies, special events and other considerations.

In addition to these preliminary results, early lessons learned from the FAST-TRAC Project include:

- The Road Commission for Oakland County learned that, though video image processing was not a mature technology at the time of installation, it is a viable traffic detection technology.
- The integration of the ATMS and ATIS has the potential to offer benefits above and beyond those that can be offered by either system individually.
- Institutional, jurisdictional and legal challenges far out weighed the technical complexities involved in implementing such an integrated ATMS-ATIS.

Test Partners

AWA Traffic Systems – America

Chrysler Corporation

City of Troy, Michigan

County of Oakland, Michigan

Federal Highway Administration

Ford Motor Company

General Motors Corporation

Michigan Department of Transportation

Michigan State University, Detroit, Michigan

Nissan Motor Company

Road Commission for Oakland County

Siemens Automotive

University of Michigan, Ann Arbor, Michigan

References

Bair, B.O., Barbaresso, J. C., and Lamparski, B.J., Overview of the FAST-TRAC IVHS Early Results and Future Plans, July 1995

Barbaresso, J. and Grubba, J. L., Overview of FAST-TRAC IVHS Program, ITS America Annual Meeting, 1993

Knockeart, R. and Bauer, T., FAST-TRAC, ITS North America, Siemens Automotive Corporation, Traffic Technology International, 1995

Public Sector Consultants, Oakland County FAST-TRAC Project Phase IIB Deliverable, September 1995

ITS Field Operational Test Summary
GENESIS

FHWA Contact: Office of Travel Management and ITS Applications, (202) 366-0372

Introduction

The Genesis ITS Field Operational Test demonstrated the use of alphanumeric personal communications devices (pagers) and personal digital assistants (PDAs) to provide traffic information in the Twin Cities Metropolitan area of Minnesota. The project began in 1992 as part of a Minnesota Department of Transportation program to reduce congestion in the Twin Cities area. This test was the second of a group of three Minnesota Guidestar tests that shared traffic information from the Minnesota Department of Transportation (MnDOT) Traffic Management Center (TMC) in downtown Minneapolis.

The test assessed whether individual user s can realize benefits from receiving real-time traffic information. The test was also introduced MnDOT to ITS technologies and broke new ground in ITS public/private partnerships.

The operational testing phase began in mid 1995 and finished in January 1996. The Final Evaluation Report was released in September 1997.

Project Description

The project team recruited 492 individuals to participate in the test, including 210 existing pager users and 239 new users. MnDOT collected and made available traffic information regarding incidents, congestion, and other delay conditions such as road construction. The test participants were trained in the use of the pagers and PDAs to access the traffic information provided by MnDOT. Figure 1 shows the Genesis test coverage area.

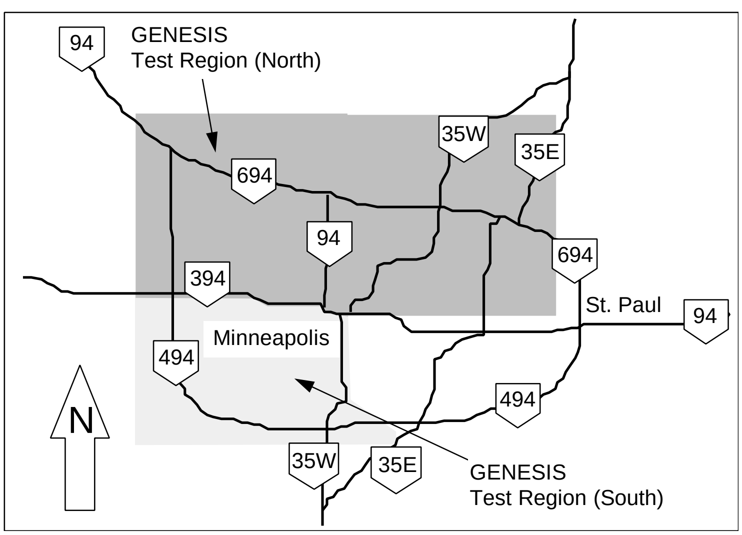


Figure 1. Genesis Test Coverage Area

The evaluation was composed of five individual supporting tests:

1. System effectiveness—analysis of origin-destination (O-D) data to determine changes in behavior and time or distance savings
2. User perception—assessment of user perception of Genesis features
3. Institutional issues—examination of technical and deployment issues
4. Modeling—an extrapolation of the system effectiveness data focused on a single expressway corridor
5. Human factors—research into workload impacts on drivers using the system.

Results

Due to technical problems the use of PDAs was extremely limited, and the preponderance of available data came from pager users. The results from the surveys and focus groups were encouraging.

From the System Effectiveness Test, 65 percent of surveyed participants reported they used the Genesis capability every day. For 52 percent, Genesis was the primary means of obtaining traffic information. The most frequent response to incident information was to take an alternate route. The results showed that those who learned about an incident through Genesis were much less likely drive through the incident (12 percent) than those who learned about it through other means (radio, television, etc. – 42 percent). Travel times were not reduced to a statistically significant level through the use of Genesis, and congestion and travel times increased on both primary and alternative routes when incidents were reported.

From the User Perception Test, overall ratings of the usefulness of the traffic information were positive. Users noted some limitations in the system, particularly with regard to the level of detail provided.

The results of the Institutional Issues Test emphasized a need for proper financial planning for ITS projects. The results also showed a need for understanding the full range of technical obstacles, primarily with regard to system integration. The results pointed out the need for better communications from both inter- and an intra-organizational perspectives.

The Modeling Test showed that the use of personal communications devices (PCDs) can reduce average travel time by up to 15 percent if the devices achieve a 20 percent level of market penetration. As the level of congestion increases the travel time savings benefits of using PCDs increase up to a point. Results from the Modeling Test conflicted with the results from the System Effectiveness test. Evaluators attributed this conflict to the limitations of the model.

The Human Factors Test concluded that using PCDs divert driver’s attention from their driving. The test found, however, that there was no evidence of this causing a safety hazard. Users noted some deficiencies in message legibility and content which can be remedied.

Legacy

The project discontinued operations upon completion of the test. There were no plans to further deploy the system as configured for the test. MnDOT has indicated that they are interested in providing this type of information to a third-party as a value added reseller.

Test Partners

- Federal Highway Administration (FHWA)
- MinnComm
- Minnesota Department of Transportation (DOT)

References

Genesis Final Evaluation Report, Booz·Allen & Hamilton Inc., September 1997.

ITS Field Operational Test Summary

Heavy Vehicle License Plate (HELP) One-Stop

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The One Stop Electronic Purchasing and Processing ITS Field Operational Test demonstrated the technology and process necessary to automate and integrate common motor carrier administrative functions across three states. The operational test demonstrated and tested the *capability* for "one-stop" electronic filing and purchase of motor carrier credentials and permits. Among the renewals and supplements that a motor carrier could process were those described in the International Registration Plan (IRP) and the International Fuel Tax Agreement (IFTA). Carriers could also use the system to obtain oversize or overweight permits. The test highlighted the benefits, to both motor carriers and state agencies, of streamlining regulatory application practices.

The test operated for nine weeks in the spring of 1997 in Arizona, California, and New Mexico. The evaluation of the test looked at five focus areas: system effectiveness, system operation, physical conditions and requirements, user acceptance, and institutional issues.

Project Description

The Heavy Vehicle License Plate (HELP) One-Stop system features a set of user friendly computer interfaces supported by multiple databases. Figure 1 presents a schematic of the electronic credentialing process. Motor carrier users, working on the HELP software, provided the application information required by each state to issue credentials and permits. The users accessed regulatory compliance information, filed applications, and transferred funds electronically through one point of contact for all three states. State agencies avoided manual entry of motor carrier data and participated in a financial clearinghouse that settled regulatory accounts among states.

Using the HELP One-Stop system, motor carriers and service agents were able to determine state-specific credential requirements for each type of credential and could submit an application for a credential. They could also set up fleet accounts, add or modify their vehicle and fleet information, calculate the fees for a credential or permit, and make electronic payments. The carriers or agents performed these transactions by accessing an electronic Service Center using a proprietary communication interface. The system also supported state agency account and vehicle processing, financial payment, and on-site credential and permit issuance.

One of the participants (Lockheed Martin IMS) supported the project with their Vehicle Information System for Tax Apportionment/Registration System (VISTA/RS) product. IRP member jurisdictions used this software to process IRP applications for carriers traveling in two or more IRP jurisdictions. VISTA/RS provided state agencies the ability to process and record IRP accounts. The test participants used the linked VISTA/RS and HELP One-Stop systems to calculate taxes and fees for the credentialing transactions.

The Service Center, set up by HELP, Inc. and Lockheed Martin IMS, acted as the primary contact point for all participating motor carriers, service agents, and state agencies. In addition to being the primary contact point for the system, the Service Center provided user training and on-site and telephone assistance to participants. The Service Center also acted as a financial clearinghouse for fee payment.

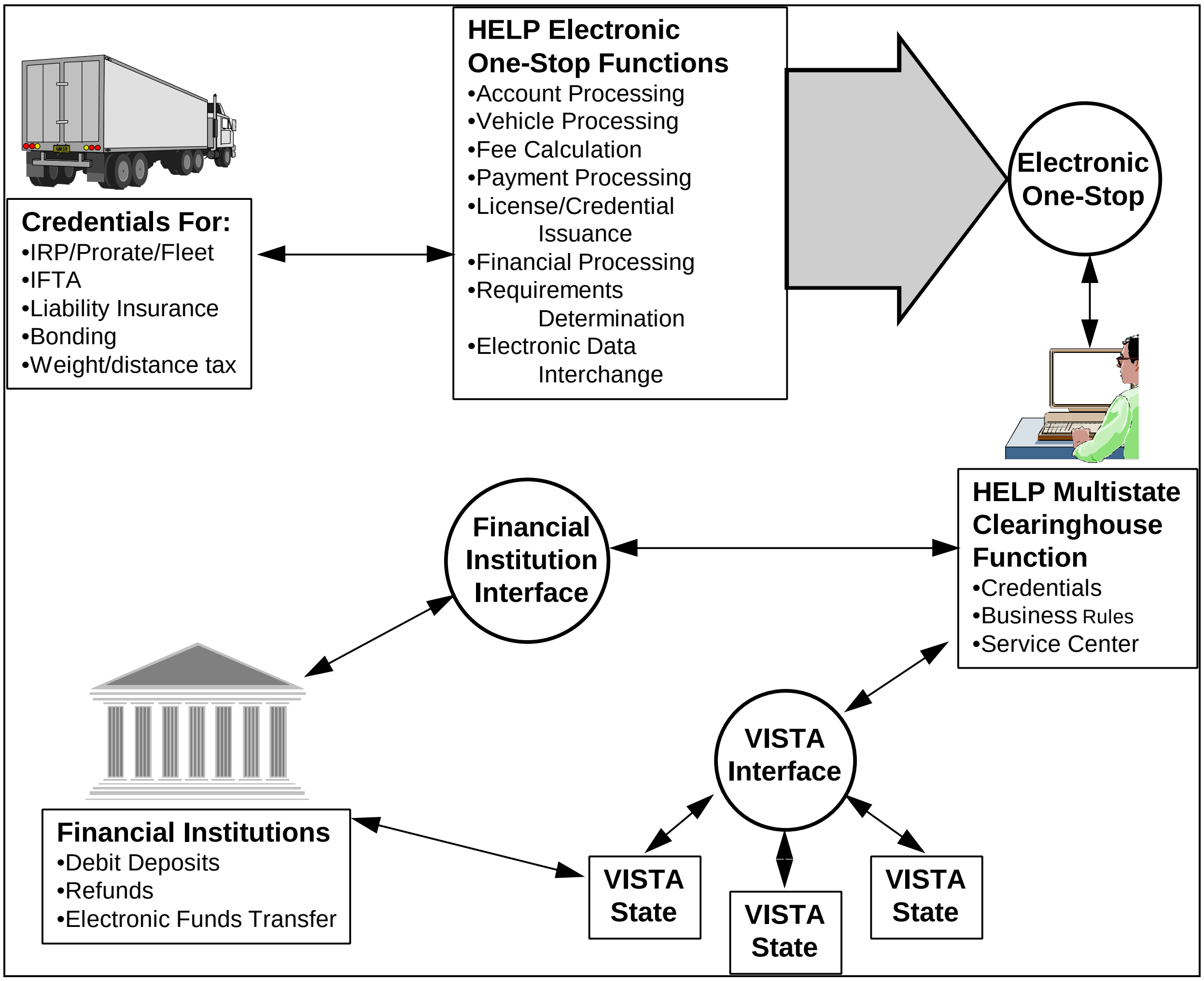


Figure 1: Electronic Credentialing Schematic

Results

The Final Evaluation Report presents the following findings.

The operational test demonstrated the viability of the one-stop concept. Test participants acknowledged the potentially large benefits of one-stop systems for their businesses. The test provided system developers with the feedback needed to improve their product. Those involved with the test were positive about the future of one-stop systems and about the potential for the system to provide them multiple benefits. Motor carrier users anticipate both time and cost savings, as well as achieving a higher efficiency than at present. The greatest benefits would accrue to large motor carriers and service agents.

The test recorded and evaluated the process of IRP transactions, IFTA requests, and permit transactions. The volume of transactions during the system operation was significantly less than expected since the test period did not cover any renewal cycles. Test personnel supplemented the recorded transactions with a series of simulated transactions.

Using the HELP One-Stop system saved about 48 days over the conventional method when obtaining IRP supplement credentials. Based on limited data, evaluators estimated a time saving of about 38 days when processing IFTA renewals. Simulated test data also show the potential for significant time savings in the IRP renewal transactions. The limited test data for oversize and overweight permits indicated that there would be little time or cost savings from using the HELP One Stop system.

The use of the service center as a financial transaction clearinghouse was cumbersome. The fee payment portion of the transaction consumed nearly 80% of the time. If the concept were actually deployed, the Service Center would not perform this function. Therefore, in an actual deployment, the evaluators expect that the fee payment time would be reduced.

The HELP One-Stop system featured a proprietary communication interface with the VISTA/RS system. Lockheed Martin IMS developed both the VISTA/RS and the EOSS software products. During testing, variations in fee calculations were discovered between states using VISTA/RS and those using other systems. These variations were small and mainly resulted from the systems using different reference data to calculate the fees. These test data suggest that the system would be most easily integrated into states already using the VISTA/RS services.

Legacy

The HELP One-Stop system was intended to be a commercial product. The development of a one-stop system that used a standard communications format would be attractive to many states. The test participants concluded that the system is not yet ready for deployment as a commercial product. The commercial test participant developing the product, Lockheed Martin IMS, has identified several components that it would change under a commercial deployment scenario to make it more attractive to a wider range of users. These components include:

- Eliminating the financial clearinghouse function of the Service Center in favor of direct payment to state accounts
- Using a larger, dedicated computer platform
- Using a standard communications format (such as Electronic Data Interchange) to make the system more attractive to non-VISTA/RS states.

Lockheed Martin IMS has not yet made a decision about deploying the system. The company does plan to use the knowledge and technology it learned during HELP One-Stop in its future commercial vehicle operations work.

Test Partners

American Trucking Associations Foundation

Arizona Department of Transportation

California Board of Equalization (IFTA)

California Department of Motor Vehicles (IRP Section)

California Department of Transportation

Federal Highway Administration

HELP, Inc.

International Fuel Tax Agreement

IRP, Inc.

Lockheed-Martin IMS

National Governors Association

New Mexico Taxation and Revenue Department

Private Fleet Management Institute

Western Highway Institute

References

The Western Highway Institute, One-Stop Electronic Purchasing and Processing, (Draft) Final Evaluation Report, July 1997

ITS Operational Test Summary

Herald En-Route Driver Advisory System Via AM Sub Carrier, Phase II

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Herald En-Route Driver Advisory System Via AM Sub Carrier, Phase II (Herald II) ITS Field Operational Test evaluates the utility of providing traveler information in rural areas. The Herald II system employs a subcarrier on a commercial AM radio broadcasting to remote areas in Colorado and Iowa. The project proposes to test the feasibility of generating, transmitting, and receiving messages over a large geographic area. The test assesses the use of AM subcarriers as a reliable, low-cost medium to communicate traffic messages in the challenging terrain of Colorado and the potentially interfering environmental conditions of Iowa.

Phase I of the test occurred from October 1995 to December 1995. Phase II began operation in 1996. A final report is expected in the second quarter of 1998.

Project Description

The Herald project is being conducted in two phases. Phase I of the test consisted of a communication technology feasibility study funded entirely by the ENTERPRISE group. [See the Test Partners section for a description of the members of this group.] Activities in Phase I included a literature search to help determine the design approach, the development of specifications, data requirements, and simulation models, the development of a prototype system, and the performance of pilot tests.

Phase II is the actual field test and evaluation and is supported by the Federal Highway Administration. This Phase consists of developing the prototype mobile receivers, modifying and installing the transmitter sites, developing message formats, and collecting, analyzing, and evaluating data. The project will assess the performance of an AM subcarrier as a basic data communication channel. The project will also assess the impact of the AM subcarrier's channel characteristics on the channel's ability to disseminate traffic messages reliably and efficiently.

The project will provide two types of services: en-route driver information and traveler services information.

Herald consists of components that will address message generation, transmission, and reception. Figure 1 shows these components. The message generation component formats the traveler information. The message transmission component translates the formatted messages for transmission. The message reception component (in the vehicle) receives, decodes, translates, and presents the data in a format useful to the traveler.

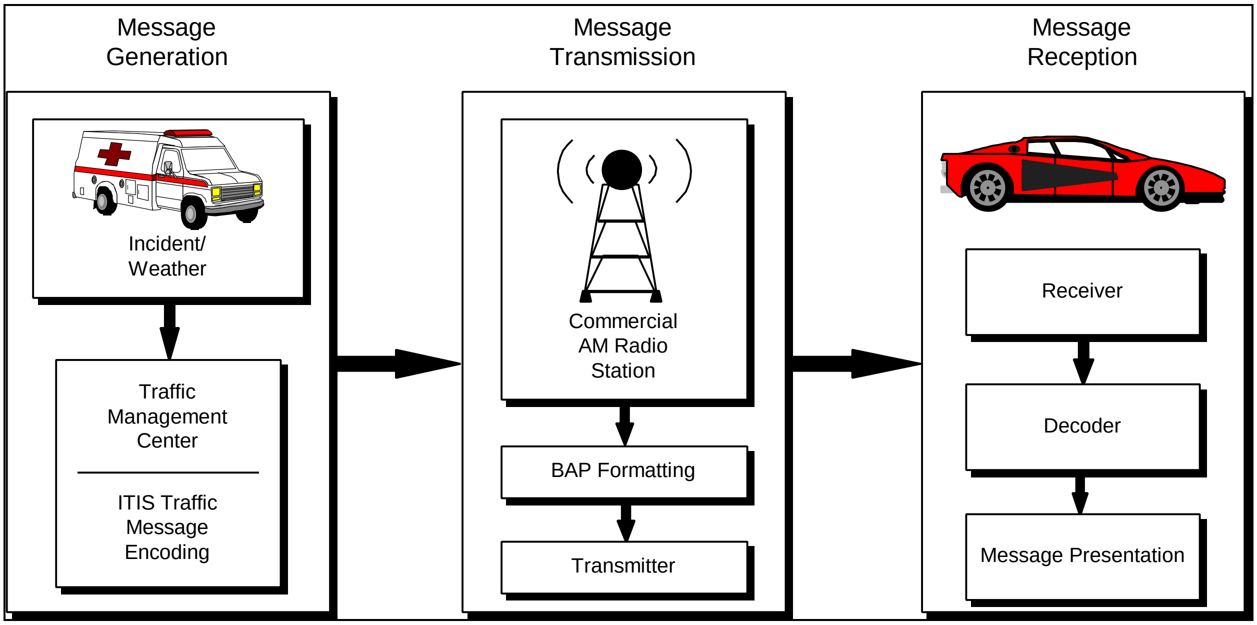


Figure 1: Components of Herald Design Concept

To test the system in the field, test personnel are setting up the transmitters and installing receivers and measurement systems in test vehicles. These measurement systems will assess the AM subcarrier performance. The testing proceeds incrementally, gathering a small data sample and analyzing it before collecting more data. Test personnel start sampling the transmission at points close to the transmitters. As the test continues, testing will occur at greater distances from the transmitters and at varying times of day. While messages are being broadcast, test personnel will measure the signal strength according to standard criteria. Test measurements will eventually be taken in all planned terrain types and times of day.

The evaluation of the project will address two significant research questions about AM subcarrier modulation technology.

- Can it provide adequate signal coverage in a rural or rugged terrain?
- Can it provide accurate traveler information?

Test Status

Test personnel are currently analyzing the initial data collected. Additional data collection is tentatively scheduled for six weeks, starting in April 1998. The evaluator will analyze the data in parallel with its collection.

Test Partners

Federal Highway Administration

Modulation Sciences, Inc.

Mobile Data Systems

The ENTERPRISE Group (Departments of Transportation from the states of Arizona, Colorado, Iowa, Michigan, Minnesota, North Carolina, and Washington, plus Maricopa County, Arizona, Dutch Ministry of Transport, Ministry of Transport Ontario, and Transport Canada)

References

None published.

ITS Operational Test Summary

Idaho Out-Of-Service

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Idaho Out-Of-Service ITS Field Operational Test is a Commercial Vehicle Operations test that evaluates an electronic enforcement tool for "out-of-service" orders. The system operates by electronically registering trucks placed out of service (OOS) by entering both the vehicle's license plate image and its transponder identification in a database. As trucks leave a weigh station, the test equipment checks if the truck has been registered as OOS. If it has been registered as OOS, the system sounds an alarm and notifies the State Police.

Test components have been in operation since early 1997 at the East Boise Port-of-Entry and the evaluation of the entire system commenced in October 1997.

Project Description

The test aims to improve highway safety and trucking operations by demonstrating and evaluating technology to monitor commercial vehicles taken out of service and to aid in efficiently clearing violations. To fulfill a congressional mandate of ensuring the safe operation of commercial vehicles, the Motor Carrier Safety Assistance Program (MCSAP) inspects commercial vehicles at weigh or inspection stations. A truck is identified as "out-of-service" if it fails an inspection. It remains out-of-service until the inspection item has been rectified. Because many inspection stations, however, are not staffed 24 hours per day, some vehicles have the opportunity to resume traveling without correcting the OOS violation ("running") after the station has closed. Other vehicles may correct the reason for the violation but be unable to have the OOS order cleared while the station is closed. The technology being demonstrated in the test can help address both situations. One of the goals of the field operational test is to deter "running," thereby increasing road safety. Another goal is to provide a method for truck operators to tentatively clear an OOS order when an inspector is not available.

The OOS system operates as follows. When a truck is placed out-of-service, the inspector registers a report of the violation in a database at the weigh station and issues a transponder to the driver. The system captures an image of the vehicle's license plate and registers the transponder number associated with the violation. When the violation has been corrected (for example, the brakes are repaired or the driver is sufficiently rested), the operator can tentatively clear the violation by interacting with a kiosk at the weigh station.

To prevent trucks from leaving the facility before correcting the violation, the system again reads the vehicle's license plate on the way out of the weigh station. The system then compares this image to the one taken previously. If the image matches that of a truck that had been placed out-of-service and whose violations have not been cleared, the system triggers an alarm and sends a fax to the Idaho State Police. The fax sent to the police includes the image of the license plate as well as additional information so that the police can apprehend the vehicle.

Figure 1 presents a schematic of a weigh station in the test.

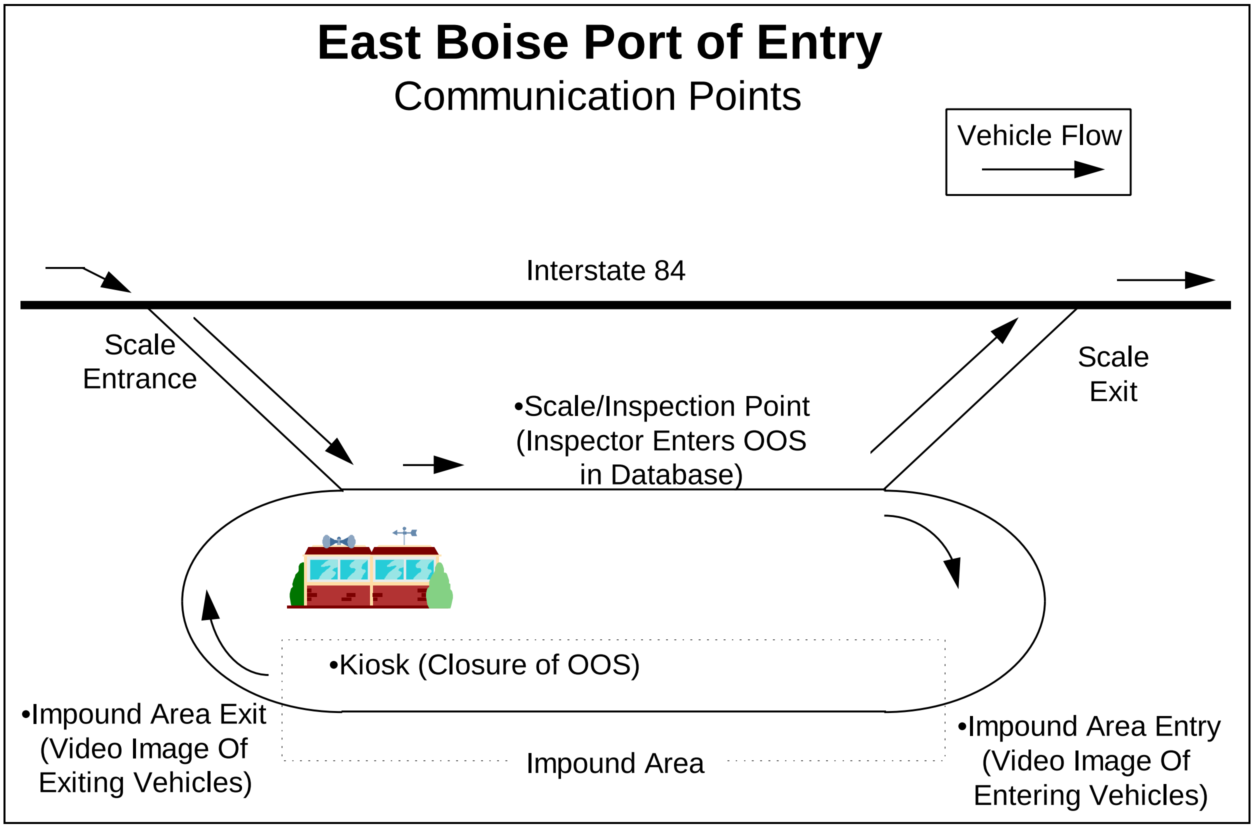


Figure 1: Schematic View of Idaho Out-Of-Service Weigh Station

The evaluation of the test will focus on the reliability, maintainability and accuracy of the components of the system. It will also estimate productivity improvements of enforcement personnel, overall cost, and the level of acceptance by motor carriers, drivers, and the police.

Test Status

System testing began in October 1997 at Idaho National Engineering and Environmental Laboratory (INEEL). Beginning in January 1998, the components that were tested at INEEL were transferred to the Port of Boise Port of Entry (POE) for assembly. The complete system should be operational by spring 1998. Detailed test results are not expected before summer of 1998.

Test Partners

3M Company

Federal Highway Administration

Hughes Missile Systems Company

Idaho National Engineering and Environmental Laboratory

Idaho State Police/Motor Carrier Safety Assistance Program

Idaho Transportation Department

References

Idaho National Engineering Laboratory, INEEL Transportation: ITS Field Operational Test (http://www.inel.gov/capabilities/transportation/oos.html), "Out-Of-Service Vehicle Field Operational Test At The East Boise, Idaho, Port Of Entry," December 1997.

ITS Operational Test Summary

Idaho Storm Warning System

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Idaho Storm Warning System ITS Field Operational Test is an Advanced Rural Transportation System test that is evaluating a system to warn motorists about adverse weather conditions. The system consists of a group of sensor systems that provide visibility and weather data coupled to a set of variable message signs (VMS) located along the highway. The system operates along a stretch of Interstate 84 in Idaho and northern Utah. The primary goal of the system is to reduce the number and severity of visibility-related multiple-vehicle accidents along this section of I-84.

Testing of the system components began in 1994. Due to a lack of visibility events in the early winters of the test and because of equipment operation problems, the data collection period has been extended until March 1998.

Project Description

The project consists of two phases. The first phase tested three visibility sensors incorporating two weather information systems The purpose of the first phase was to determine the suitability of the sensors and weather systems for use in Phase II. The first phase also established the baseline information regarding driver behavior on the test section of Interstate 84 in southern Idaho. The second phase is integrating the sensing technologies and a set of variable message signs (VMS) into an alarm and warning system to advise motorists of adverse visibility conditions.

The project need and purpose arose because of the history of accidents on a 100-mile long section of I-84 (see Figure 1). Certain areas in the test location are subject to low visibility conditions caused by blowing snow during winter and dust during spring. This section of I-84 also functions as a passenger and commercial vehicle travel route between Boise, Idaho, and Salt Lake City, Utah. From 1988 to 1991, this area experienced 18 major visibility related accidents, according to Idaho Transportation Department statistics. The percentage of trucks involved in these accidents (44 percent) exceeds their proportional representation (33 percent) in the traffic stream.

The project intended to reduce the number and severity of accidents on the subject section of I-84. The purposes of Phase I include evaluating the capability of three sensor systems to provide weather and visibility information and establishing baseline information about vehicle speeds before the installation of VMSs. In Phase II of the project, test partners are installing and integrating the VMSs. They are also evaluating the capability and suitability of the entire system in providing weather and visibility information to motorists.

Phase I of the test installed and evaluated three sensing systems: SCAN, Handar, and LIDAR. The SCAN system incorporates two separate visibility sensors, one using visible light and the other using infrared light. This system also includes four weather measurement sensors for wind speed and direction, air temperature, relative humidity, and type and amount of precipitation. The Handar system includes weather sensors similar to the SCAN system and a point detection visibility sensor similar to the visible light sensor of the SCAN system. The Light Detection And Ranging (LIDAR) system is a single visibility sensor using advanced laser technology. The LIDAR system operates similar to radar systems and can provide visibility measurements over a larger area than the other two technologies. During this phase, test personnel also used a video camera system to provide real-time verification of the conditions at the test site. Information from all these systems was transmitted to a master data collection computer at the Cotterell Port of Entry (POE) facility. The computer collected and analyzed sensor data every five minutes and alerted POE personnel if visibility fell below a predetermined threshold. If a visibility event occurred, system operators at the Cotterell POE confirmed the event using the video system. In Phase II when the operators confirm a low visibility event, they will manually activate the VMSs to advise motorists.

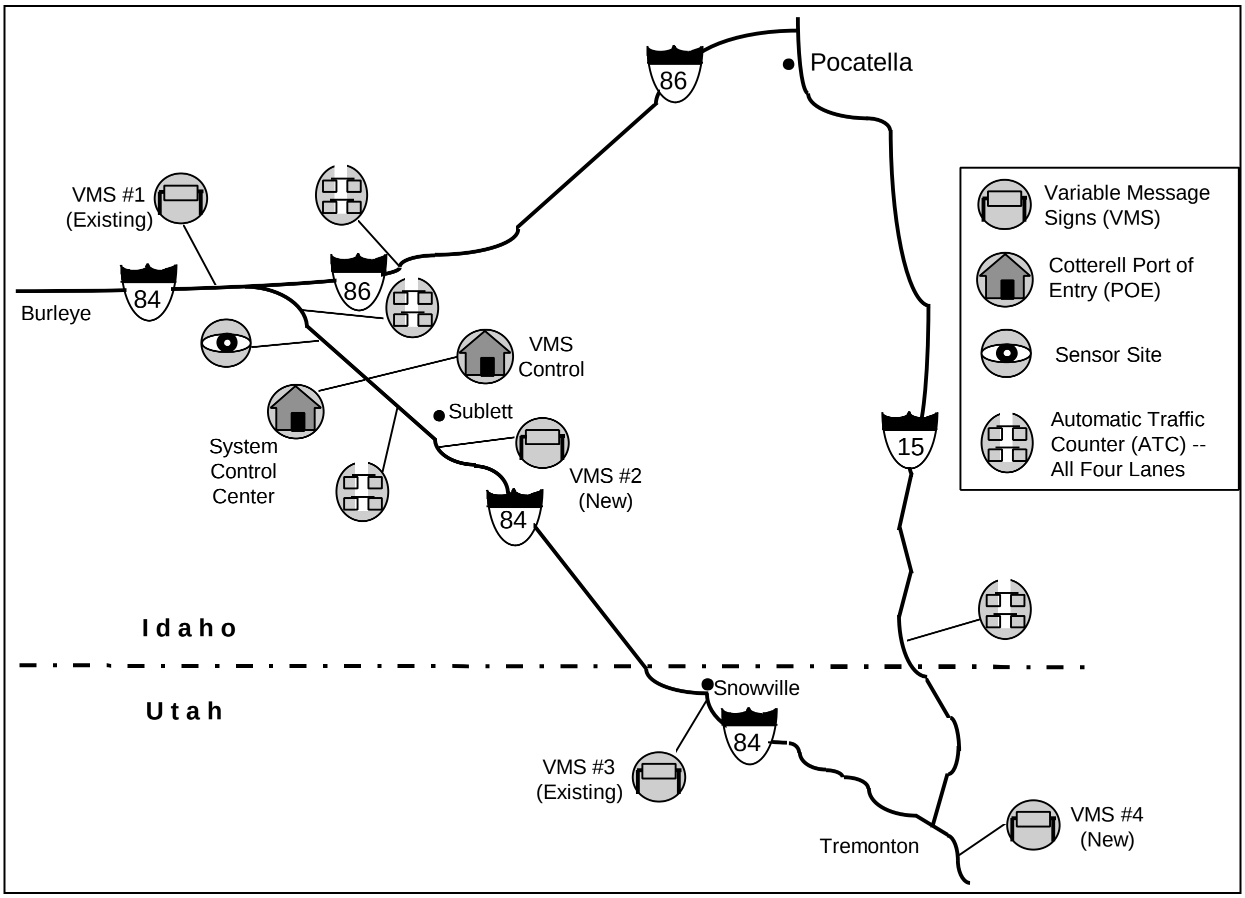


Figure 1: Map of Project Location

Test Status

Phase I of the test is continuing in parallel with Phase II, which began in November of 1996. Due to equipment operation problems and the lack of visibility events in winter 1996/1997, data collection has been extended until March 1998. The results presented in this summary come from an interim report on Phase I dated January 1997 and a progress report for the winter of 1996/1997. The LIDAR system visibility sensor was not operational during the winter of 1995/1996 as reported in the Interim Report. The test defines a visibility event as one in which sight distance drops below 1,200 feet. According to available sensor information, there were no visibility events during the winter of 1996/1997. The LIDAR system did operate during this later period but the accuracy of the LIDAR data is subject to question because the system was still being calibrated. The Final Report is expected in August 1998.

The primary purpose of Phase I of the test was to determine whether the three sensor systems were capable of measuring visibility accurately. Test evaluators analyzed the visibility sensor effectiveness through three methods: POE personnel confirmation, video playback visibility comparison, and correspondence between the operating sensors.

The POE personnel confirmation and the video playback comparison were both subject to many problems that reduced their effectiveness as an accurate confirmation method. POE personnel confirmation problems included technical problems that caused the POE personnel to lose confidence in the system and the complicated and time-consuming nature of the method. Video playback problems included an ineffectiveness at determining precise visibility distances and several technical problems that resulted in limited availability of information. Considering the limited information available using POE personnel confirmation and video playback, this confirmation method shows general agreement between the observations of the personnel and the sensors' visibility during several event periods. Precise correlations, however, proved to be impractical due to differences in individual judgment and the POE personnel's busy schedule of other duties.

Despite the problems that reduced the effectiveness of the video playback confirmation method, the available Handar and SCAN data show a general agreement between the observed distances in the videos and the sensor distances.

The comparison of visibility readings from the Handar and SCAN sensing systems (involving three different sensors) showed that this comparison is unable to determine if the sensors provide accurate visibility distances. The sensors do, however, show a high correlation between themselves. Although they provide significantly different visibility readings, it was common to have correlation values of over 0.900 between different sensors. In particular, the infrared sensor tended to give lower visibility readings during snowy conditions but higher readings during foggy conditions compared to the two visible light sensors. In spite of these differences, the three sensors showed a strong, positive linear relationship. This means that when one sensor shows a decline in visibility, the other two also exhibit a decline. Conversely, when visibility improves according to one sensor, the others also show improvement.

The LIDAR information from the winter of 1996/1997 indicated more frequent low visibility readings than the other sensors. As noted earlier, however, the LIDAR system was still being calibrated. The LIDAR system shows the complexity of visibility measurements because it produces visibility estimates at one-quarter mile intervals for up to several miles away from the site. These discrete quarter-mile estimates show significant variations in visibility (as much as several thousand feet) from one interval to another. This implies that information from point sensors like Handar or SCAN is highly dependent on sensor location.

The information from Phase I indicates that the sensors have the potential to provide useful information regarding low visibility. The mixed results, however, mean that in Phase II it is important to have information from all three sensors to determine the nature of the message to be displayed on the VMSs.

Test Partners

Federal Highway Administration

Handar Incorporated

Idaho Transportation Department

National Weather Service

Santa Fe Technologies

Surface Systems Incorporated

References

Shannon, Dr. P., Kyte, Dr. M, and Liang, W. L.; Idaho Storm Warning System ITS Operational Test, Phase 1 Interim Report, January 1997

Liang, W. L., Kyte, Dr. M., Shannon, Dr. P.; Idaho Storm Warning System ITS Operational Test, Progress Report for Winter 1996/1997, Evaluation of Weather and Traffic Conditions, December 1997

ITS Operational Test Summary
Integrated Corridor Traffic Management

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Integrated Corridor Traffic Management (ICTM) ITS Field Operational Test uses advanced adaptive control technology to improve traffic efficiency. The test partners are implementing ICTM along an eight-mile segment of the I-494 corridor south of the Minneapolis - Saint Paul (Twin Cities), Minnesota, metropolitan area. This segment of the corridor crosses multiple jurisdictions and suffers from high levels of recurrent traffic congestion. Authorities anticipate that the congestion will increase significantly in the near future. The ICTM project, conceived by Minnesota Guidestar, proposes to attain optimum corridor capacity through the application of an adaptive traffic control system that responds rapidly to changing traffic conditions. ICTM integrates freeway management, via ramp meters, with signal optimization on parallel and perpendicular surface arterial streets. The project aims to reduce congestion on the freeway by more effectively using the capacity of the parallel arterial system to accommodate locally generated, short trips.

The test is currently operational and evaluation data collection is underway. Originally scheduled for completion in December 1998, the test has been extended by one year to provide a longer evaluation period. The final evaluation report is expected in December 1999.

Project Description

Minnesota Department of Transportation, the project leader, forged a partnership across several jurisdictions affected by the project corridor. The main objectives of the test are:

- Implement an adaptive traffic control strategy that rapidly responds to anticipated and unanticipated fluctuations in traffic flow due to recurrent congestion, incidents, and special events
- Demonstrate that multiple transportation agencies can work together to improve travel conditions throughout the I-494 corridor
- Integrate available advanced technologies to collect and disseminate corridor information
- Provide comprehensive motorist information services.

The Integrated Corridor Traffic Management system synchronizes the operation and management of signalized intersections and freeway entrance ramps within the corridor. The system uses the Sydney Coordinated Adaptive Traffic System (SCATS), developed in Australia, to control the traffic signals and metered ramps included in the project. This project is the first SCATS-based integration test involving freeway and arterial management systems. It aims to accommodate increasing traffic demand in a heavily congested freeway corridor (I-494) by providing optimized, efficient, responsive, and flexible signal operations during both normal traffic flow and during incidents, emergencies, and special events. Figure 1 depicts the project area consisting of an eight-mile section of I-494, four parallel east-west arterial streets, and seven perpendicular north-south arterial streets.

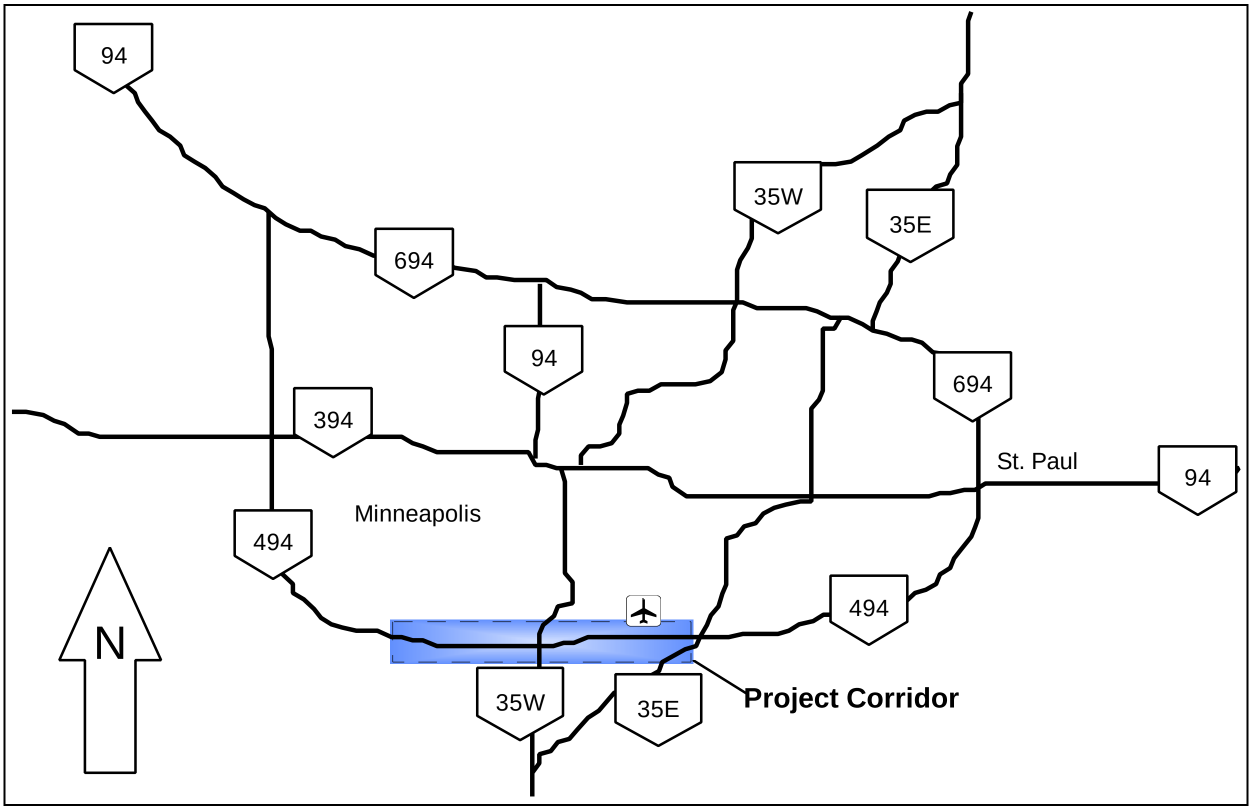


Figure 1: The Project Corridor in Minneapolis-Saint Paul, Minnesota

The project is being implemented in four modules spanning a four to five year period. Table 1 presents the deployment plan showing the components in each module.

Modules 1 & 2, 1995		Module 3, 1996	Module 4, 1998
• System hardware and software • 21 Traffic signals • Video detection at four sites • Develop Communication Plan	• System integration • 27 Ramp meters • Develop Operation Plan • Training	• 41 Traffic signals • 11 CCTV on arterial system • Two on variable message signs on I-494 • Training	• Motorist information devices • Implement Operations Plan • Refine Incident and Special Event Plan

Table 1: Project Deployment Plan and Components

The management system uses state-of-the-art tools to increase the capacity of a transportation corridor. These tools include incident management and adaptive control for arterial traffic signals and ramp metering. These tools are considered core transportation investments that optimize the return on the invested dollars.

Ramp metering minimizes freeway traffic turbulence and disruptions by breaking up platoons on the ramps and releasing vehicles one by one from the metered signal. The tested ramp metering technology provides a greater and more flexible level of control than has been historically feasible. The tested technology uses optimizing algorithms to manage traffic flows. It provides the opportunity to link freeway and arterial management by coordinating ramp meters and traffic signals. The existing, first generation freeway management ramp metering system software serves as a fallback.

The physical meters and the layout of the ramps remain the same as the historical system with most ramps operating as two lanes on the approach to the meter. Metered red times under the new system will range from 0.5 to 22 seconds with the ability to vary the time in 0.1 second increments. The previous system had only six ramp metering rates with a minimum red time of 3 seconds. The system uses queue detectors on the ramps to balance queues and turn the ramp meters off when not needed. The system increases green frequency for ramps with longer queues and reduces it for ramps with shorter queues while maintaining the same rate of overall traffic entry to the freeway section. The new software also allows ramps to be ranked in importance, permitting, for example, freeway to freeway ramps to be given preferential treatment over entrance ramps from surface streets.

The test evaluation will use collected traffic data, documented project information, and interviews with system managers and operators. The evaluation will also rely on surveys and focus groups of motorists, business people, and residents. The evaluation focuses on corridor capacity utilization, corridor operating conditions, adaptive control benefits, corridor safety, project and system deployment cost, value to agencies, and institutional and legal issues.

Test Status

The test and evaluation activities associated with Modules 1, 2, and 3 are complete. Test personnel have installed all field devices and equipment except for that equipment that supports the incident management component. The installation of the remaining equipment and devices will be completed by the summer of 1998. Data collection activities for module 4 are scheduled for April and May 1999.

The evaluation results associated with adaptive ramp metering have been very positive. The system operators perceive adaptive ramp metering as an effective tool to implement metering strategies for recurrent traffic congestion. This conclusion is significant since the operators' expectations of adaptive control effectiveness were already high because of a historically well managed ramp metering system.

Test Partners

City of Bloomington

City of Edina

City of Richfield

Hennepin County

Federal Highway Administration

Minnesota Department of Transportation

TransCore

References

ITS International, Issue Number 13, November/December 1997

ITS Operational Test Summary

International Border Electronic Crossing (IBEX)

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The IBEX ITS Field Operational Test demonstrates an electronic border clearance system to accelerate commercial vehicle traffic through the Otay Mesa, California, international port facility. The primary objective of the project is to develop and demonstrate critical ITS components of an integrated service that will allow selected vehicles to pass through international border check points with expedited inspections or without stopping.

The system has been in operation since September 1996. Evaluation data collection will continue through January 1998. The final report is expected in March 1998.

Project Description

The goal of the IBEX FOT is to deploy ITS technologies as part of an integrated system designed to expedite the processing of commercial freight movements at international land borders. As part of the International Border Clearance (IBC) Program, the Federal Highway Administration (FHWA) has worked with the system developer to implement an electronic border crossing system. The system, in cooperation with the US Treasury's North American Trade Automation Prototype (NATAP) program, aims to significantly reduce the delay incurred by commercial vehicles at international points of entry.

Shippers and carriers conducting international freight movements incur significant burdens because of the administrative processes that they must follow when entering and exiting the US at international border crossings. The international trade community and government officials responsible for customs, immigration, and transportation must execute a complex set of transactions and inspections in order for vehicles, drivers, and cargo to legally and safely cross from one country into another. Because a large portion of these transactions are conducted manually, the time required to process an individual shipment can be significant. At land ports, such as the Otay Mesa, CA border facility, commercial vehicle traffic volume has grown to the point where lengthy processing delays are commonplace. These delays impact the trade community by increasing costs and adversely affecting the efficiency of operations.

The IBEX system addresses these delays by providing for the electronic exchange of customs, immigration, and transportation data between the trade community and the appropriate regulatory agencies. Using electronic vehicle logs, on-vehicle sensors, and electronic cargo seals, the system provides the capability to store and forward carrier, vehicle, and cargo information. Figure 1 presents an overview of the IBEX system.

As an enrolled vehicle passes the *advance* reader location at the approach to the border crossing inspection/processing compound, the IBEX system electronically screens it using dedicated short-range communications (DSRC). The system reads carrier, vehicle and cargo identification data, in the form of a trip/load number, from a transponder installed in the vehicle cab. IBEX forwards this information through the Traffic Facility Integrated Communications (TRAFIC) system to the NATAP system. When the vehicle reaches the US Customs primary inspection point, the *decision* reader reads the transponder a second time. This action prompts the TRAFIC system to relay information received about the carrier from the NATAP system to the display in the customs primary inspection booth. The NATAP information consists of immigration and trade related documentation regarding the status of the carrier, driver and cargo. Based on the information provided to the customs inspector, customs inspectors instruct the driver to proceed either to the compound exit or to a secondary, more detailed inspection. The customs inspectors relay these instructions to the driver via a red or green signal displayed both on the transponder and on a traffic signal adjacent to the primary inspection booth. The system reads the transponder a third and final time as the vehicle reaches the exit of the compound. If all inspections have been completed satisfactorily, and all required documentation is in order, the system gives the driver a green light to exit the compound.

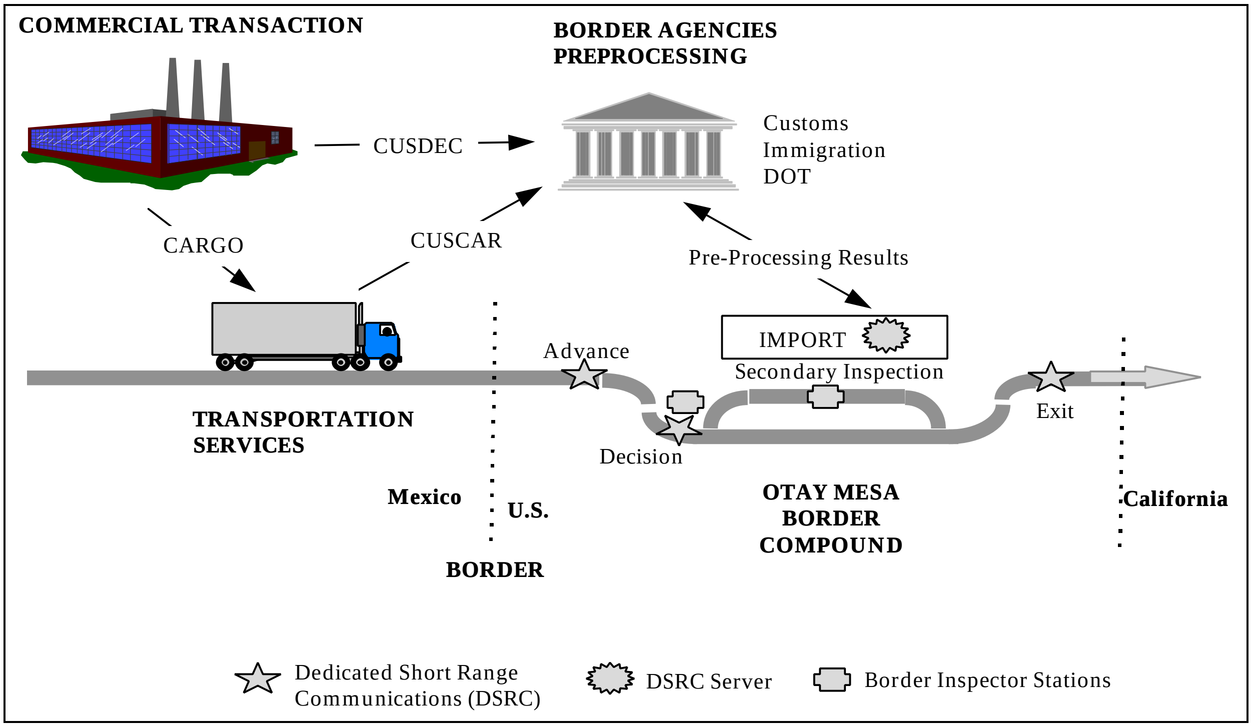


Figure 1: IBEX System Overview

The evaluation focuses on four goal areas:

- Document the technical performance of the IBEX technologies at the component level
- Determine the user acceptance of the IBEX services and technologies
- Evaluate the potential impacts of the IBEX services and technologies to the transportation processes for international movement of commerce and evaluate the interfaces with the trade community
- Document transportation institutional issues and lessons learned.

Test Status

The TRAFIC system and all associated DSRC components have been operational since May 1997. The on-vehicle brake sensors have undergone some system development testing. Evaluation data collection will be completed in February 1998, with the final report expected in

March 1998.

Test Partners

Federal Highway Administration

CALSTART

Signal Processing Systems (SPS)

California Department of Transportation

California Highway Patrol

CASAS International

Sony

References

None published.

ITS Operational Test Summary

Irvine Integrated Ramp Meter/Adaptive Signal Control

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Irvine Integrated Ramp Meter/Adaptive Signal Control (IRM/ASC) ITS Field Operational Test demonstrated an integrated system to adjust traffic on freeway entrance ramps based on existing traffic volumes and speeds in the total highway network (freeway and adjacent arterial highways and streets). The test has three major foci: a systemwide adaptive ramp meter system (SWARMS), an adaptive traffic signal control system, known as Optimal Policies for Arterial Control (OPAC), and integrated corridor control using the above freeway and arterial components.

The test has three purposes:

- Evaluate the performance of adaptive ramp metering
- Assess the technical and performance issues of using OPAC on an arterial
- Assess the use of SWARMS and OPAC for corridor management.

The test is located in the City of Irvine, in Orange County, CA. Data collection will occur in September 1998. A final report is expected in March 1999.

Project Description

Existing signal control systems, in general, adjust signal timing according to the conditions at a single intersection or freeway entrance ramp. In some cases, the signal timing may be coordinated among a series of intersections. The Irvine Field Operational Test is an attempt to control signals by taking account of the "big picture" of traffic conditions over a significant section of the freeway and arterial street network. The SWARMS and OPAC tools will facilitate the coordination of signal timing and policies along a transportation corridor spanning several transportation agencies. Figure 1 presents a diagram of the Irvine IRM/ASC project.

The SWARMS component of the test is designed to provide a system-wide approach to freeway management. SWARMS will be installed on all freeways in CalTrans District 12 (Orange County). Freeways will be divided into sections, with each section reflecting similar traffic congestion characteristics. Ramp meter rates will be set using algorithms that take account of local traffic conditions, and conditions on other freeway sections. The intent is to improve overall network efficiency.

The OPAC component of the test consists of a deployment of OPAC at approximately 30 existing signal controlled intersections. The intersections to be included are on Alton Parkway, located between and generally parallel to I-5 and I-405. Adaptive traffic control offers the potential for reduced traffic congestion and smoother traffic flow, by predicting when 'platoons' of traffic from one intersection will arrive at the next intersection downstream. During the intervening period, the control system can give priority to traffic on cross streets. As part of the OPAC deployment, 2070 controllers will be installed at OPAC intersections, and loop detectors will be installed 600 to 800 feet upstream (compared to existing detectors at 200 to 300 feet).

The integrated corridor management component of the test will assess the combined use of SWARMS and OPAC for a multi-agency approach to freeway and arterial management. Test personnel will develop an arterial response plan (ARP) to support CalTrans District 12 and the City of Irvine as they manage freeway incidents. The ARP will facilitate selection of appropriate traffic management plans to divert freeway traffic to Alton Parkway and then back to the freeway. Traffic management tools for this effort include signal timing plans and changeable message signs on the freeway and arterials.

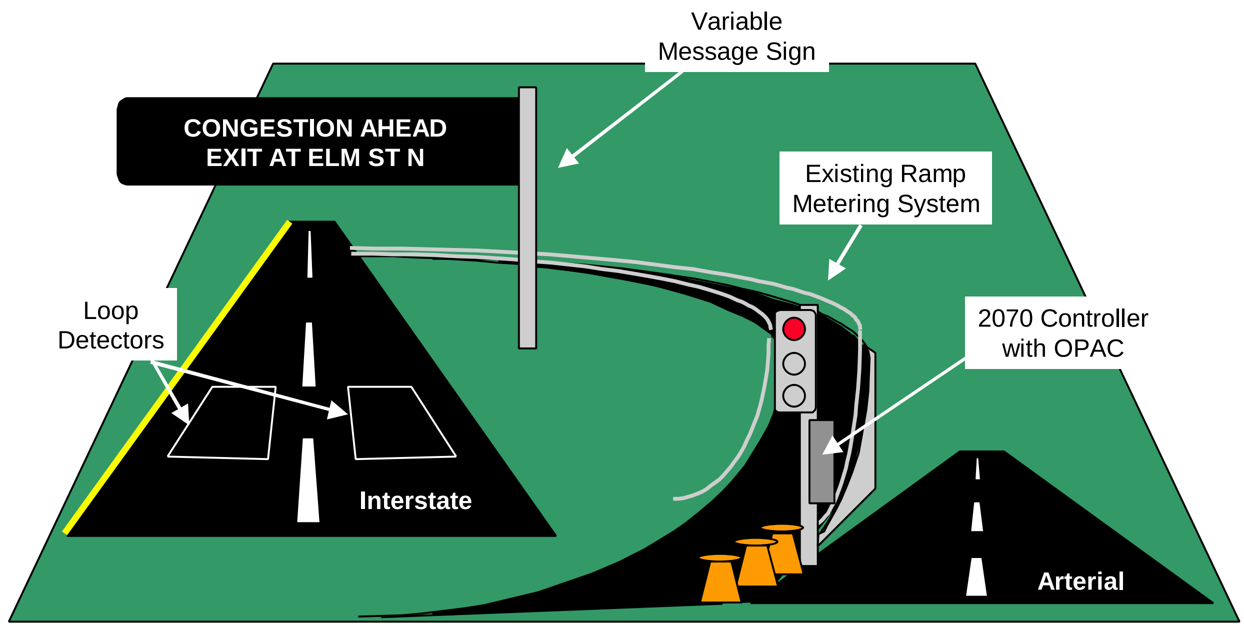


Figure 1: Irvine IRM/ASC Diagram

Test Status

Data collection will commence in September 1998. The final report is due in March 1999. No results are currently available.

Test Partners

California Department of Transportation

City of Irvine

Federal Highway Administration

P.B. Farradyne (OPAC)

References

None published.

ITS Field Operational Test Summary

Midwest Electronic One-Stop Shopping

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Midwest Electronic One-Stop Shopping (MEOSS) ITS Field Operational Test was conceived to demonstrate the application of technology to enhance the efficiency of the commercial vehicle credentialing and permitting processes. Software designed specifically for the program was intended to help ease administrative burdens placed on motor carriers and state agencies by automating portions of the process and reducing the time required to obtain the desired credential through the use of electronic data interchange (EDI). Representatives from thirteen motor carriers, two commercial leasing companies, and one motor carrier association, and various agencies from the states of Minnesota, Wisconsin, Illinois, Missouri, Kansas, Nebraska, and South Dakota, participated in the test.

Data collection occurred from April to October 1997. The Final Report is expected in early 1998.

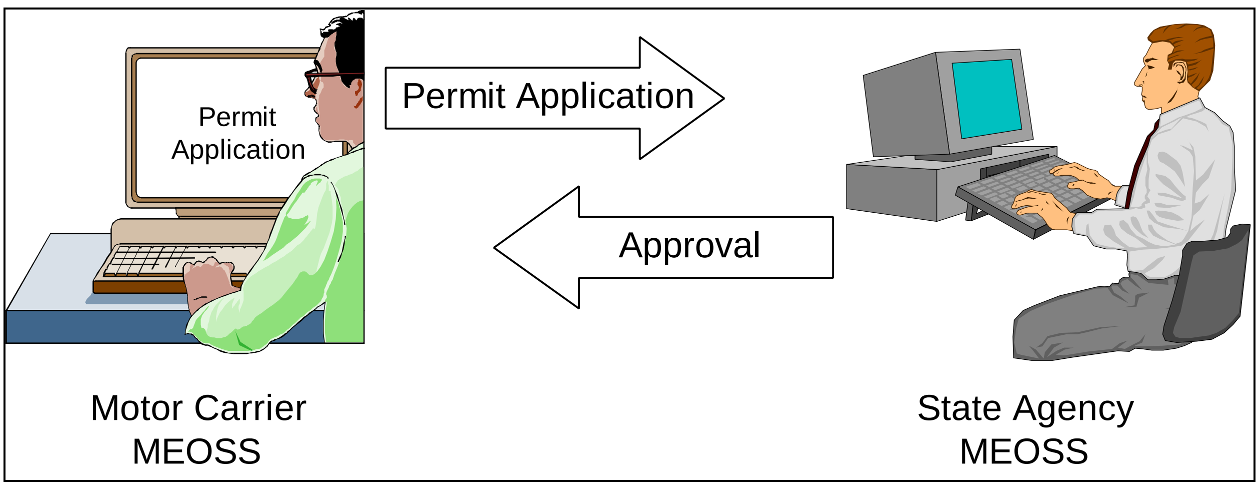


Figure 1: System Overview

Project Description

The MEOSS test evaluated the potential benefits and costs of "one-stop" electronic handling of motor carrier credentials. Using MEOSS, motor carriers could complete applications for credentials and permits using a PC/Windows based software application, the file them with the state electronically via modem. State agencies could then access the application electronically, review the information, and transmit an approval or rejection back to the carrier. MEOSS, thereby, attempted to reduce the credential cycle time by eliminating the need to mail or hand carry applications and credentials. Using the MEOSS system, a motor carrier could:

- Apply for and receive vehicle registration under the International Registration Plan
- Register to pay fuel taxes under the International Fuel Tax Agreement

- Register for Single State Registration credentials and permits
- Apply for and receive Oversize/Overweight permits.

The system had the potential to further decrease the cycle time by providing a validation feature aimed at reducing the likelihood motor carriers would submit an incomplete or incorrect application.

Participating carriers and agencies typically installed the MEOSS system on one or two desktop personal computers. Since the MEOSS software did not incorporate a data import function, users were required to manually enter data. The data entered was stored the system database.

The evaluation of the test is looking at several focus areas, including system productivity impacts, user acceptance, system deployability, institutional issues, system performance and suitability, and system accessibility.

The data collection consisted of a set of surveys (before and after implementation) as well as personal interviews with both carrier and state personnel. In addition, a data collection function was incorporated into the MEOSS software to automatically capture and log transaction data.

Test Status

Carriers and agencies used the system from April to October 1997, when data collection concluded. The evaluators are analyzing the data and preparing the final report. Final results are expected early in 1998.

Test Partners

FHWA

Thirteen motor carriers, two commercial leasing companies, and one motor carrier association

State agencies in: Illinois, Kansas, Minnesota, Missouri, Nebraska, South Dakota, Wisconsin

Iowa State University Center for Transportation Research and Education

AAMVAnet, Inc.

RS Information Systems, Inc.

References

AAMVAnet, Inc., Midwest Electronic One-Stop Shopping System, February 27, 1997

ITS Operational Test Summary

Mobile Surveillance/Wireless Communication

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Mobile Surveillance/Wireless Communication (MobileComm) ITS Field Operational Test addresses traffic management challenges in areas where traditional traffic detection and ramp metering systems are not available. The test uses portable trailers to provide a combination of video image traffic detection, ramp metering, and data and control transmission. The system is being evaluated in the City of Anaheim, California and on Interstate 5 in Orange County, California.

There are two tests of the system at different locations. Test II, in the City of Anaheim, operated in the spring of 1997. Test I, on the Interstate, will operate in the spring of 1998. The results of the test are being evaluated and the final report is expected in December 1998. This cooperative effort includes partners from both the public and private sectors.

Project Description

Traditional buried loop traffic detectors coupled to surface communications lines are costly to install, are subject to interruptions during construction, and generally cannot provide surveillance and communications cost-effectively at special events or remote locations. This operational test implements and evaluates an integrated mobile system that provides traffic surveillance and control capabilities in areas where traditional loop detectors are disabled or not installed.

The test system consists of three components. The video image processing (VIP) component houses equipment to detect traffic volumes and speeds and to relay data. The ramp metering component contains ramp metering equipment (portable traffic signal heads) that operates in concert with the VIP equipment to regulate traffic. The communications component provides spread spectrum radio communications to communicate data and signal control instructions between the portable units and control and observation centers. There are three control and observation centers, the CalTrans District 12 Traffic Management Center (TMC), the City of Anaheim TMC, and the University of California Irvine Institute of Transportation Studies. An enclosed surveillance trailer houses the VIP and communications component. An open trailer houses the ramp metering component. Figure 1 presents a typical installation on a freeway entrance ramp.

In Test II, the surveillance trailers were deployed to assist with the management of special events in the City of Anaheim. In Test I, surveillance units and ramp meter trailers will be set up on selected Interstate 5 freeway entrance ramps. The surveillance trailers will also be used in conjunction with the ramp metering trailers on I-5.

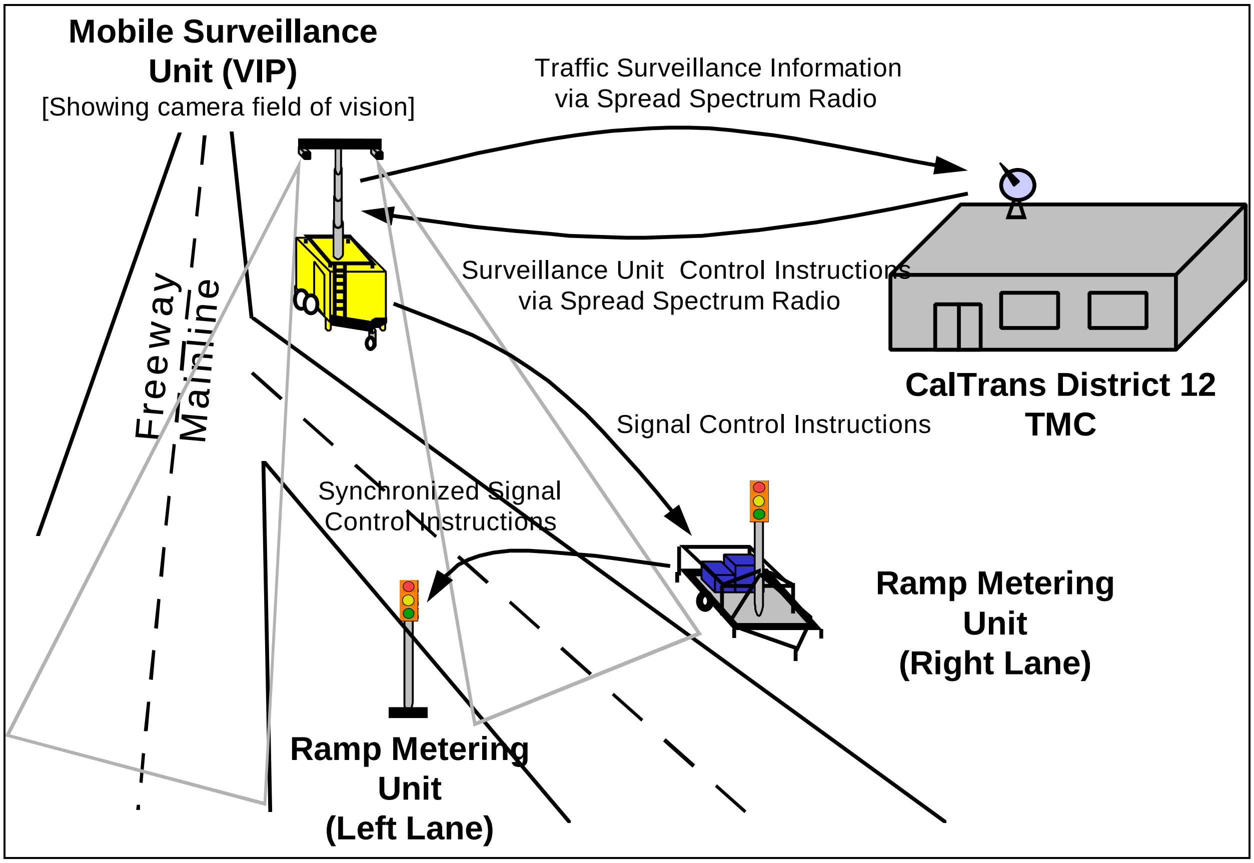


Figure 1: Typical Entrance Ramp Installation

The evaluation of the test results focuses on the performance, portability, and stand-alone benefits of the mobile surveillance system. The evaluation is assessing the performance of the components of the system and their portability. It will also assess the cost of the deployed system and the institutional issues encountered during the test.

Test Status

Interim results are not available at this time. The Final Report is expected in December 1998.

A magazine article describing the use of this technology to manage special events (Test II), indicated positive benefits. This article quoted a test evaluator describing a 37 percent reduction in average parking lot exit time compared to not using the equipment.

Test Partners

California Department of Transportation

California Highway Patrol

City of Anaheim

Federal Highway Administration

Hughes Aircraft Company Transportation Management System

University of California at Irvine

References

Taylor, Steven T., "Crowd Pleaser," ITS World, January/February 1998

ITS Operational Test Summary

Multi-Jurisdictional Live-Aerial Video Surveillance System—Virginia

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

This ITS Field Operational Test demonstrated the use of live aerial video to improve traffic management operations. A rotary wing aircraft operated by Virginia's Fairfax County Police Department recorded the video. The aircraft transmitted the signal to ground stations for re-transmission and use by Fairfax County and the Virginia Department of Transportation (VDOT). VDOT used the video for incident management and traffic control. The test covered an 8-month period from July 1993 to April 1994.

Project Description

Three Fairfax County police helicopters were equipped with a video camera. The camera weighed less than 100 pounds, and had a 3-watt power output that limited transmission range to 20 miles. Figure 1 illustrates the configuration of the test system.

The six-power camera mounted on the helicopter took video coverage of the traffic situation as it

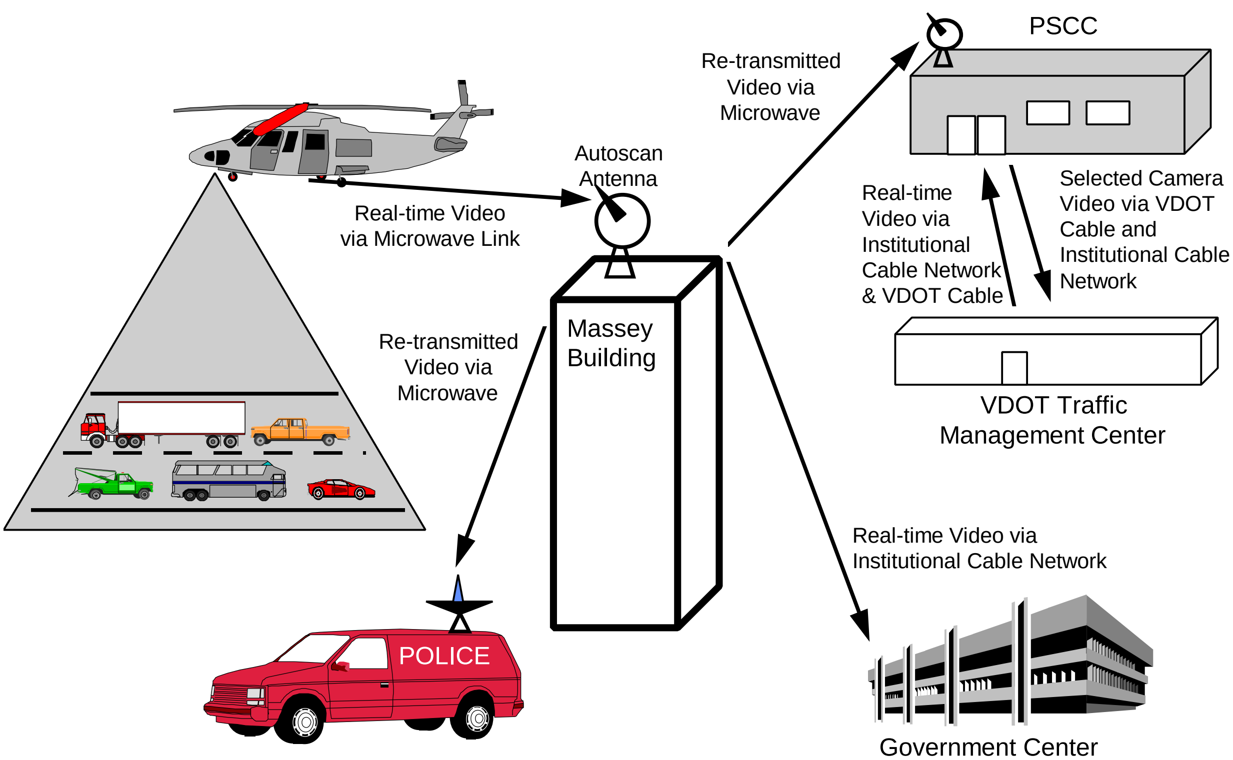


Figure 1: Live Aerial Video System High-Level Configuration

flew over the highways in the county. A transmitter on the helicopter sent the signal to a ground station (Massey Building in Fairfax City). The ground station received the signal via a pole-mounted rotating antenna. The ground station re-transmitted the signal to the Fairfax County

Public Safety Communications Center (PSCC) and a Fairfax County Police Department van. The ground station also sent the signal to the Fairfax County Government Center over a commercial cable link. The PSCC and the VDOT Traffic Management Center in Arlington exchanged video images via cable links.

The helicopter flew twice a day, during peak traffic hours, over a set flight path. The flight path was only interrupted for critical situations. Any change to the flight path required special coordination, since the helicopter was a police asset dedicated to law enforcement tasks. VDOT and the police coordinate very closely on a daily basis in response to incidents and congestion.

The project evaluation focused on three main objectives:

- Demonstrate a cost-effective technical approach to the capture and transmission of video images of traffic incidents and congestion throughout a major urban area
- Identify and develop resolutions for institutional issues related to privacy, security, and interagency sharing of equipment and information
- Demonstrate the utility of the video images for incident management and traffic control.

Results

The test found that the use of aerial video by a transportation agency offered distinct benefits for both real-time traffic operations and long-term analysis of traffic facilities and conditions. The key purpose of the system was the effective communication of traffic conditions to the traffic management agency, the motoring public, and decision makers. Real-time benefits resulting from enhanced communication during an incident included:

- Effective selection of alternate routes for motorists and emergency vehicles
- Rapid identification of secondary incidents
- Efficient deployment of response resources to the incident scene.

The test identified several institutional issues including:

- Ethical conflicts—showing of incident details to the general public
- Potential for a public organization to give or sell aerial video information to private traffic information services
- Potential for a private traffic information service to provide the same service to a public transportation agency.

Although no special events were handled with the use of live aerial video, it was clear that the benefits of having video for such events would be significant. Off-line capabilities included rapid, cost-effective analysis of current and future traffic conditions, and an illustrated view of a jurisdiction’s incident response procedures.

Legacy

This service is being continued with cooperation from the Fairfax County Police Department and VDOT Northern Virginia Traffic Operations Center.

Partners

Virginia Department of Transportation

Fairfax County, Virginia

Federal Highway Administration

References

Demetsky, M. J., Evaluation of Live Aerial Video for Traffic Management (Draft), Virginia Department of Transportation, Transportation Research Council, July, 1994.

ITS Field Operational Test Summary

North Seattle Advanced Traffic Management Systems

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The North Seattle Advanced Traffic Management Systems (NSATMS) ITS Field Operational Test is developing and implementing an area-wide, multi-jurisdictional advanced traffic management system (ATMS) in the Seattle metropolitan region. The Washington State Department of Transportation joined forces with public and private partners in the greater Seattle area to design a system to control inter-jurisdictional arterial roadways and freeways and to share traffic data. The system serves as a test bed for ITS technologies such as advanced traveler information systems (ATIS), advanced public transportation systems (APTS), automatic vehicle identification (AVI) and video imaging.

System deployment will be completed by the third quarter of 1998. Inclusive dates for the evaluation of the project have not yet been determined.

Project Description

The NSATMS is a multi-jurisdictional effort to develop a regional traffic monitoring and data sharing system. The system will offer agencies and communities throughout the greater Seattle area access to timely traffic data. The system's goals are to promote agency coordination and cooperation throughout the Seattle area, to manage area traffic more efficiently, and to serve as a data source for future metropolitan transportation planning and operations efforts.

The NSATMS establishes a computer network of remote workstations that provide the user access to a common database of frequently updated information about traffic conditions throughout the Seattle area. The system also provides information about the status of traffic control equipment in the area of coverage. Additionally, the system supports the region's commitment to ridesharing, transportation demand management, and HOV facilities. It will build on the area's historical strengths in transportation system management.

Test Status

The North Seattle ATMS test partners signed a development contract in September 1994. This contract began the development of the system for gathering arterial data from numerous agencies and jurisdictions in North Seattle. The original plan was to give the ATMS limited control over the local agency signal systems through designed signal plan changes. After numerous meetings, however, the test partners modified the plan to focus on gathering and sharing data among the partners. The ATMS will still have limited control of state owned signal systems within the freeway system and on state roads.

In April 1996, the development contract was modified to change the operating system from IBM OS2 to Windows NT. This change delayed project completion for a full year. Despite the delay, the project plan demonstrated the feasibility of coordinating traffic data sharing. The plan was incorporated into the Seattle Model Deployment Initiative along with plans for similar ATMS centers in South and East Seattle.

The North Seattle ATMS is being deployed in three phases. Test partners anticipate deployment to be completed by the third quarter of 1998. The first phase is presently underway. The first phase implements the central server system and links it with the WSDOT freeway management system (TSMC). The second phase will combine data from a variety of signal systems among the participating agencies. The final phase will include software delivery to agency sites.

Figure 1 illustrates the complete communication coverage that will share data among all the elements in the NSATMS. When all three ATMS centers are fully operational, more than 25 different agencies will have access to traffic information concerning the entire Seattle metropolitan area. These agencies include cities and counties in the Seattle area as well as transit agencies and the Washington State Transportation Center at the University of Washington (TRAC). The system will also share data with two other field operational tests, SWIFT and TravelAid.

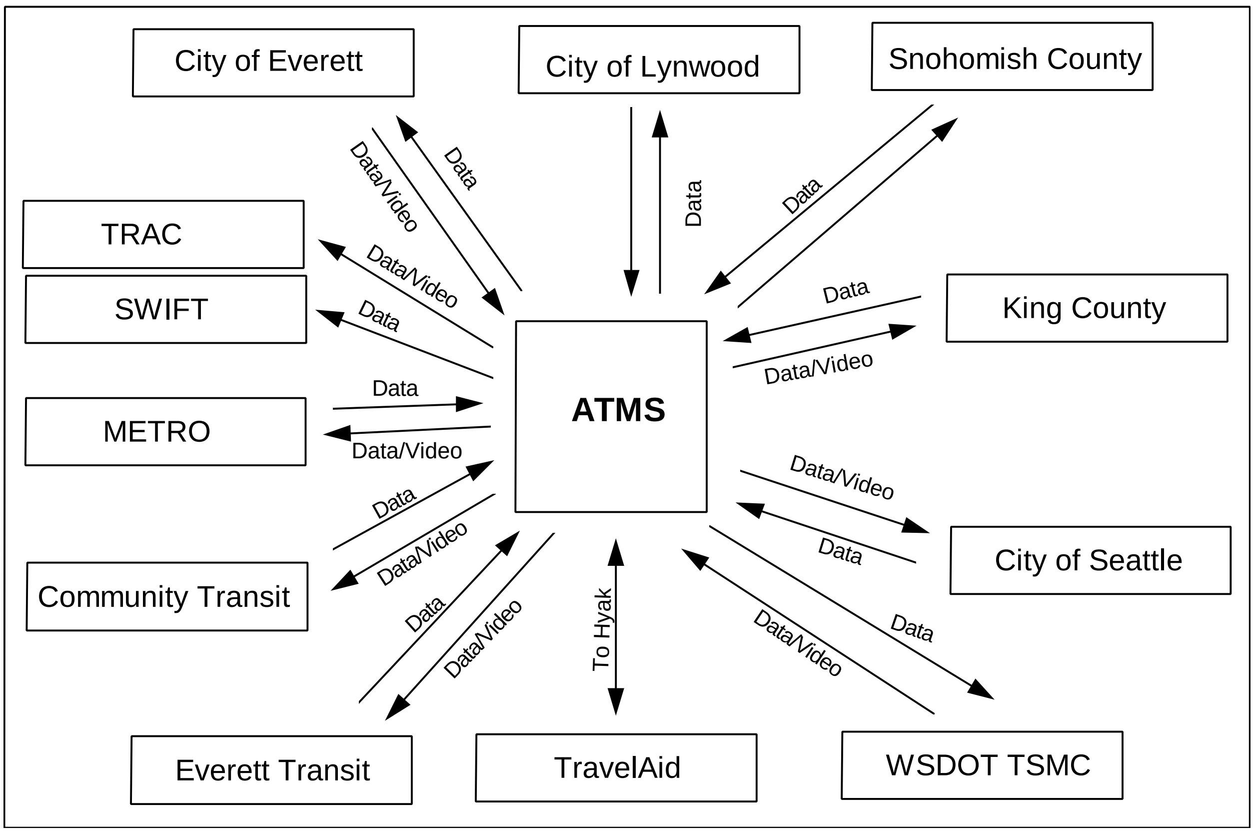


Figure 1: NSATMS Communications Overview

Test Partners

City of Everett

City of Lynnwood

City of Marysville

City of Seattle Engineering Department

Community Transit

King County

Metro Transit

P.B. Farradyne

Snohomish County

Washington Department of Transportation

Washington State Transportation Center (TRAC), University of Washington

References

None published.

ITS Operational Test Summary

Operation Respond

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Operation Respond ITS Field Operational Test demonstrates a hazardous material (HazMat) identification and tracking system called Operation Respond Emergency Information System (OREIS). The OREIS software system acts as a communications routing service between HazMat carriers and emergency response units. The project demonstrates several advanced communication and information handling technologies that provide faster information and improved capabilities to emergency response units. The goal of the test is to improve emergency response to hazardous material incidents involving motor carriers and/or railroads.

Operation Respond Inc., the not-for-profit organization developing the system, has installed the OREIS in several locations throughout the country and in Canada and Mexico. The organization is improving the operation of the system based on the experience of those installations. This Field Operational Test addresses the testing and evaluation of the system in Philadelphia, Pennsylvania, and Houston, Texas.

Test personnel are installing the OREIS software in Philadelphia. They also expect to integrate the software into the TranStar traffic management center in Houston beginning in March 1998.

Project Description

Operation Respond provides a central point of communication for the dissemination of HazMat information. Participating HazMat carriers (railroad and motor) establish a database of information about the identification and contents of their HazMat shipments. The database may also contain information about how to respond to an incident involving the shipment. Each shipment registered in the database has an identification code.

In the event of an incident or accident involving a registered shipment, police and fire personnel can quickly obtain details of the shipment involved. The units responding to the incident can identify the shipment either by the railroad car ID or motor carrier ID. The police or fire dispatcher calls the OREIS point of contact. The dispatcher supplies the shipment code and the OREIS software directs the request for information to the correct carrier database. The dispatcher then obtains the details of the shipment. Knowing the details of the shipment, the first responders can decide upon the appropriate response to the incident. Emergency response personnel can quickly request the appropriate equipment or materials necessary to contain, combat, or mitigate the effects of hazardous materials involved in the incident. Figure 1 presents a schematic of the system's operation.

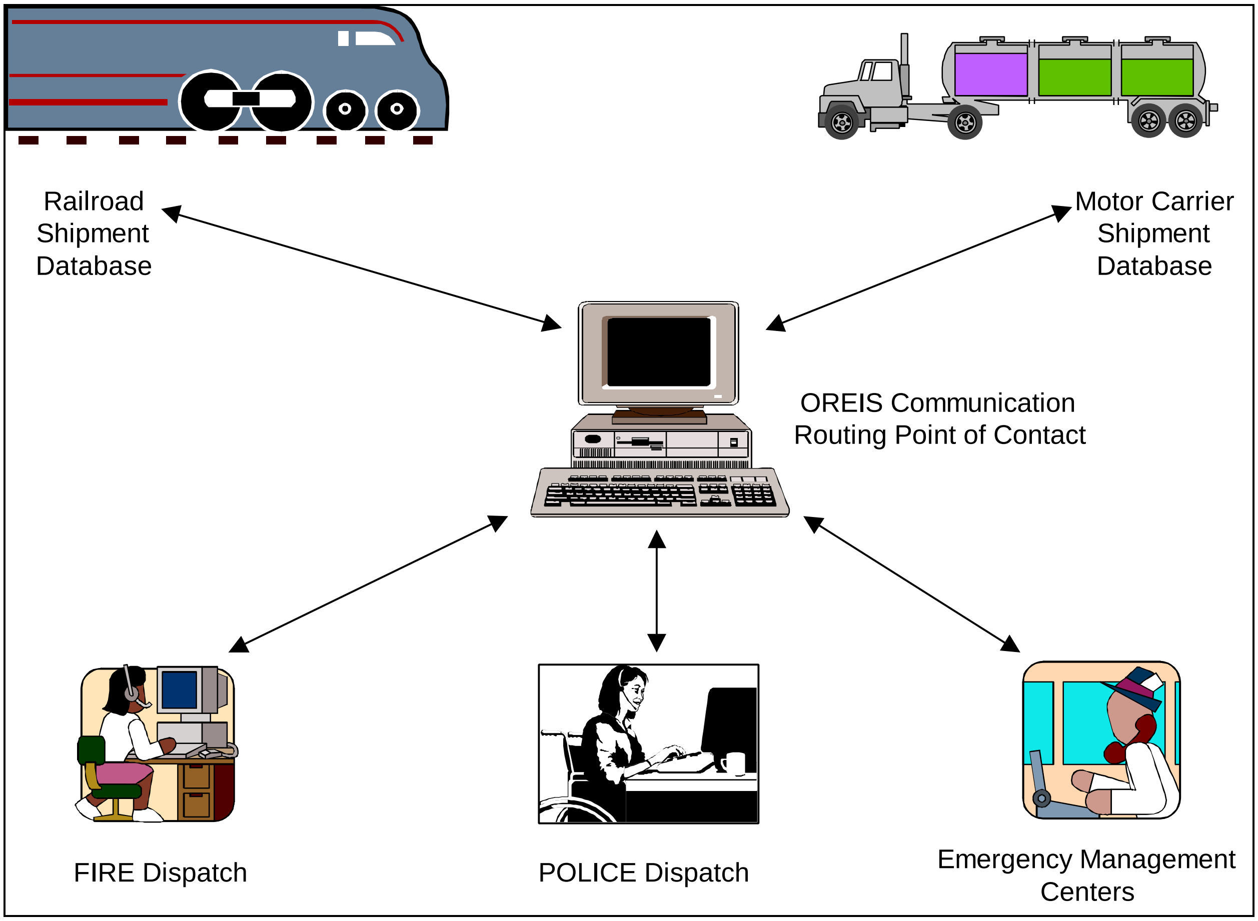


Figure 1: Operation Respond System Schematic

The Philadelphia and Houston operational tests are evaluating the system's ability to improve response time to HazMat incidents and to ensure that the appropriate organizations and equipment respond to the incident. The tests are also evaluating the system's ability to improve the accuracy of the response -- applying the appropriate treatment based on a better knowledge of the materials involved. In addition, the tests are examining the costs of implementation to both the public agencies and the transportation carriers.

Test Status

In Philadelphia, test participants are continuing to install the OREIS software in various emergency response centers. A draft evaluation plan has been completed. The Federal Railroad Administration will direct future evaluation efforts.

Houston was the site of the original Operation Respond installation. The project is returning to install the system at TranStar, the Houston regional traffic management and emergency response center. Both the installation and evaluation aspects of the Operation Respond system in Houston are in the preliminary planning stages.

Test Partners

Federal Highway Administration

Federal Railroad Administration

Operation Respond Institute, Inc.

References

Operation Respond Institute, Inc., "White Paper," January 1996

Office of Hazardous Materials Safety, Research and Special Programs Administration, Operation Respond: Lesson Learned, February 1997

ITS Operational Test Summary

Oregon Green Light Commercial Vehicle Operations Test

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Oregon Green Light ITS Field Operational Test is an evaluation of three major technical components intended to enhance commercial vehicle operations throughout Oregon. An electronic preclearance system employs transponders and weigh-in-motion (WIM) devices to reduce required stops by commercial vehicles at 22 weigh stations. The Road Weather Information Systems (RWIS), installed at Ladd Canyon, Columbia Gorge, and Siskiyou Summit collects weather data, processes it, and automatically informs motorists of abruptly changing weather conditions. The Downhill Speed Information Systems (DSIS), located at Emigrant Hill and Siskiyou Summit, calculates and displays a safe downhill speed for each passing truck.

Systems are being installed and data collection will began in fall 1997.

Project Description

The project is testing systems to make commercial vehicle operations safer, more efficient, and less expensive to both operators and the general public.

The goal of the electronic preclearance system is to improve highway safety at and around weigh stations. Installing the system will also modernize and automate a manual weighing system that has been in place for decades. The preclearance system will streamline commercial vehicle traffic flow at weigh and inspection stations. Streamlining operations includes reducing time lost at weigh stations, lowering fuel consumption and pollution, and improving allocation of enforcement resources resulting in increased compliance. Electronic preclearance will also reduce the number of vehicles that exit and rejoin the traffic stream at weigh and inspection stations (often at a reduced speed), thereby enhancing safety for all motorists.

The purpose of the DSIS is to increase road safety by reducing the average downhill speed of trucks. Similarly, the RWIS aims to increase the safety of all motorists by reducing average speeds in inclement weather and by providing pre-trip travel planning information (for example, on the Internet or through kiosks). In addition, the RWIS should reduce the application of environmentally harmful abrasives. The sensors, databases and data interchange protocols associated with Oregon Green Light also have the potential to automate tax administration, thus reducing costs to commercial vehicle operators and the tax payer.

Participating trucks are equipped with transponders that electronically identify the truck to roadside readers as the trucks approach weigh or inspection stations. Through a private "transponder administrator," the test is making transponders available to carriers in good safety standing. Initially, 10,000 transponders were introduced. The test eventually plans to equip 10 percent of all trucks operating in the state - about 26,000 vehicles.

In the electronic clearance component of the test, an antenna reads the identification information from the transponders of approaching trucks and relays it to a central processing unit (CPU). The CPU also receives an approximate weight of the vehicle as measured by WIM. With these two inputs, the system consults the database of motor carrier information. Considering its built-in rules, the electronic clearance system decides whether to give the truck a green light or direct it to enter the weigh or inspection station. Figure 1 presents a schematic of this component of the test.

For the evaluation of the electronic clearance component, test personnel will determine the rate of compliance with safety regulations directly through an analysis of the state weighmaster database and the state inspection database. The number of transponders in the test is not expected to be large enough to lead to perceptible changes in the operation of weigh stations. Therefore, the test will use a computer model to extrapolate the observed results to a full deployment scenario. This simulation will estimate the impact of full deployment on number of vehicles processed, waiting time, and fuel consumption.

The DSIS measures the vehicle weight using WIM and reads the license plate using a video system. The DSIS computes an advisory speed for each vehicle and displays it on a variable message sign next to the vehicle's license plate number.

The project installed the RWIS in locations of rapidly changing weather patterns. A sensor package measures air and pavement temperatures, dew point, wind speed, visibility and precipitation. An on-site remote processing unit (RPU) autonomously detects hazardous conditions and displays a warning message on variable message signs. The RPU communicates with a central processing unit (CPU) in Salem, which displays all alerts on a website as well as on kiosks installed in major truck stops. From the CPU a system operator can also override the RPU and display other messages.

For the evaluations of RWIS and DSIS components, existing weigh-in-motion sensors will measure the ratio of mean speeds before and after installation. Test personnel may need to supplement this data with measurements made with a radar gun. In addition, Oregon's accident records database will provide the number of accidents both before and after installation.

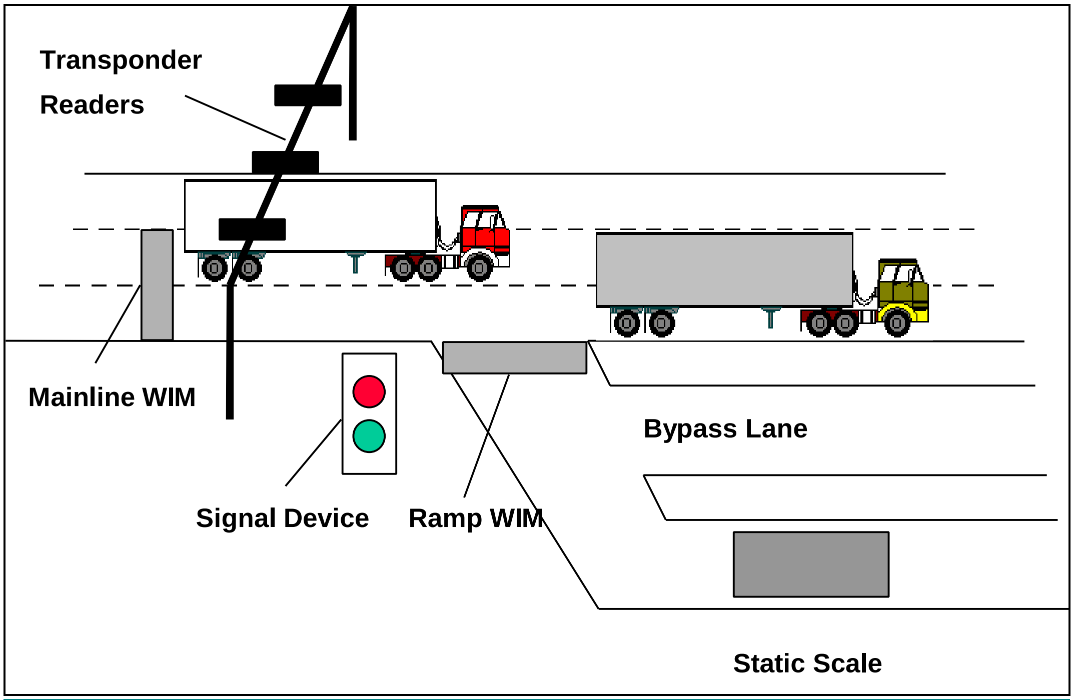


Figure 1: Schematic of Electronic Clearance

Test Status

The first pre-clearance-equipped weigh station began operations in October 1997. Two other stations are nearing the operations phase and system hardware is being installed at several others. Contractors completed installation and testing of the RWIS equipment in the third quarter of 1997. Installation of the DSIS at one site is progressing. Test personnel continue collecting speed and accident baseline data for comparison to the post-installation information.

In light of the large scale of both test and evaluation, the earliest results are expected in January 1998. The final report is due in April 2000.

Test Partners

Federal Highway Administration

Iowa State University - Center for Transportation Research and Education

Oregon Department of Transportation

Oregon State University - Transportation Research Institute

WHM

References

Oregon Green Light CVO Project, Quarterly Report, 3rd Quarter 1997, Oregon Department of Transportation, October 1997.

ITS Operational Test Summary

Peace Bridge Intelligent Transportation Border Crossing System

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Peace Bridge International Transportation Border Crossing System ITS Field Operational Test (ITBCS) is located on the Peace Bridge between Buffalo, New York and Fort Erie, Ontario, Canada. The test demonstrates the use of ITS technologies as a means to reduce the delays incurred by users of the bridge. The project's goal is to enable commercial vehicles and daily commuters to cross a "transparent" international border. The main objective is to provide an accredited service to both the border officials and agencies and bridge users that allows pre-processed vehicles and drivers to more quickly pass through international border check points, and electronically pay for bridge tolls.

The test operations commenced in May 1997 and are scheduled to be completed in November 1998, with the final report expected in November 1998.

Project Description

The international trade community and government officials responsible for customs, immigration, and transportation, must execute a complex set of transactions and inspections in order for vehicles, drivers, and cargo to cross legally and safely from one country into another. Because many of these transactions are conducted manually, the time required to process an individual shipment can be significant. At land ports, such as the Peace Bridge, commercial vehicle traffic volume has grown to the point where lengthy processing delays are commonplace. These delays impact the trade community by increasing costs, and adversely affecting the efficiency of operations. The increasing volume of commercial vehicles also has potential safety implications. As part of the IBC (International Border Clearance) Program, the Federal Highway Administration has worked with representatives from the New York Department of Transportation, the Peace Bridge, the US Treasury's North American Trade Automation Prototype (NATAP) program, and Canadian transportation officials to cooperatively address these issues.

The result is an IBC system that aims to significantly reduce administrative delays incurred by vehicles at international points of entry. The system also facilitates the safety screening of commercial vehicles. The ITBCS will facilitate vehicle processing using dedicated short-range communications (DSRC) for trade and transport related commercial vehicle electronic screening, toll collection, and dedicated commuter lanes. The end goal is to supplant current paper-based processes with one supported by electronic data interchange (EDI). The system polls transponders installed in approaching vehicles. Based on the vehicle identification transmitted by the transponder, the system accesses stored information to debit toll accounts and allow pre-cleared commuter vehicles and pre-screened commercial vehicles to pass without stopping. The system supports the exchange of information between the trade community and regulatory agencies responsible for customs, immigration and transportation. Figure 1 shows the ITBCS overview for commercial vehicle screening and clearance.

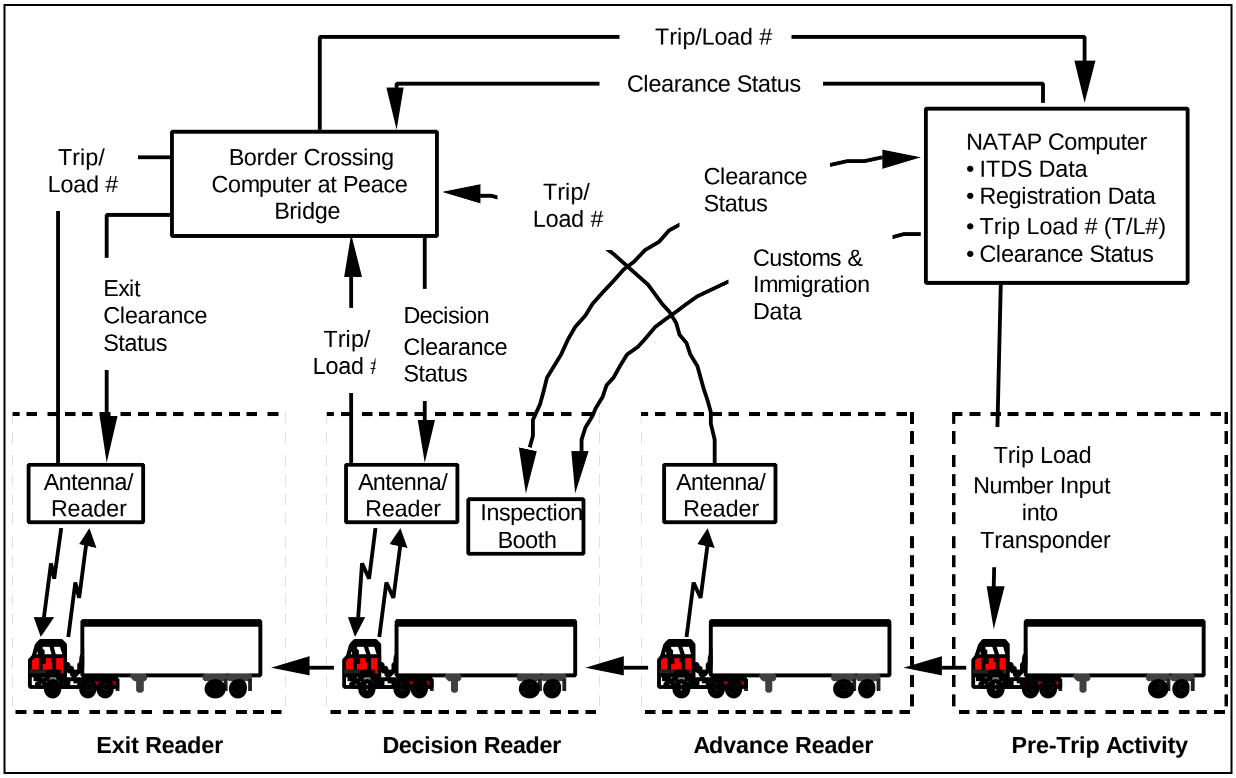
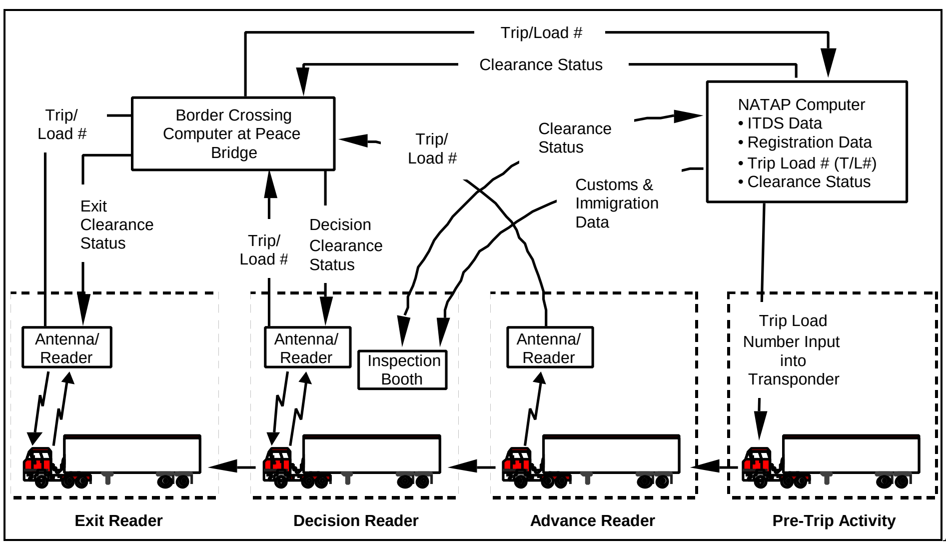


Figure 1: ITBCS Overview for Commercial Vehicles



As a commercial vehicle approaches the border facility, the system electronically screens enrolled vehicles at the advance reader location using DSRC. The reader reads carrier, vehicle and cargo identification data, in the form of a trip/load number, from a transponder installed in the vehicle cab. The reader forwards this information through the ITBCS Border Crossing Controller (BCC) computer to the NATAP system. Weigh-in-motion scales and automated vehicle classification devices gather vehicle weight and classification data and forward it to the BCC computer.

When the vehicle reaches the US Customs primary inspection point, the decision reader reads the transponder a second time. This action prompts the BCC computer to relay information, received from the NATAP system, to the display in the customs primary inspection booth. The NATAP information consists of immigration and trade related documentation regarding the status of the carrier, driver and cargo. Based on this information, the customs inspector instructs the driver to proceed either to the compound exit or to secondary inspection. A red or green signal, displayed both on the transponder and on a traffic signal adjacent to the primary inspection booth, relays the inspector's instructions to the driver. As the vehicle leaves the compound, the exit reader reads the transponder a third and final time. If the vehicle has completed all inspections satisfactorily and all required documentation is in order, the system gives the driver a green light to proceed.

The primary evaluation tool to be used is a simulation model. This model will predict travel conditions on and around the bridge once the technology has been introduced and is in use by a reasonable set of commercial and passenger vehicles. Test personnel will collect measurable parameters such as transit time, inspector utilization, and congestion for different levels of technology market penetration. Analysis of these parameters will allow evaluators to make informed decisions regarding the impacts of full-scale deployment.

The evaluation focuses on assessing the:

- Potential improvements in the transit times
- Potential reduction in the burden of compliance to shippers and carriers
- Potential reduction in costs to the bridge authority and regulatory agencies.

The primary objectives of the test evaluation are:

- To quantify the potential benefits of the ITBCS, including those that accrue to the bridge authority, the regulatory agencies, and the vehicle operators
- To investigate the institutional barriers that must be overcome to realize the full benefits of such a system

The primary expected benefits are:

- Reduction in transit times to the commercial and passenger vehicles that cross the border at the Peace Bridge
- Greater accuracy in targeting inspection activities to minimize the resources that must be expended clearing low risk vehicles.

Test Status

System operations began in May 1997 and are presently ongoing. The evaluation is scheduled to conclude in November of 1998.

Test Partners

City of Buffalo, New York

Calspan SRL

Federal Highway Administration

Fort Erie Public Bridge Authority

TransCore

References

None published.

ITS Field Operational Test Summary

Puget Sound Emergency Response Operational Test (PuSHMe)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The PuSHMe ITS Field Operational Test evaluated an advanced Vehicle Control & Safety System in the Puget Sound area of Washington State. The project combined the resources of government, private industry, and academia to implement and test a regional mayday system. A mayday system allows a driver to send a signal to a response center giving his or her location and the driver's need for assistance.

The test evaluated the technical performance of the systems and studied usability, marketing, and institutional issues. Testing occurred from November 1995 to May 1996.

Project Description

The project evaluated the simulated performance of the mayday system under actual field conditions. The project deployed two potentially competing systems developed by commercial vendors. Paid participants simulated emergencies by driving to specified locations and initiating several types of emergency calls. The test evaluated the effectiveness and response time of various steps in the call initiation and response process. In only one subtest did the calls go beyond the response center operator.

Test personnel conducted three types of performance tests. The User Group Deployment test covered the systems' operations in a variety of settings. The Simulated Service Delivery test tracked a mayday scenario from call initiation through the arrival of simulated emergency service (see Figure 1). The Specific Features tests focused on performance issues of the hardware, cellular networks, or the service centers. The tests also analyzed usability, marketing, and institutional issues.

The PuSHMe project simulated a real-life test environment to determine the operational, technical, and institutional requirements to proceed with the full-scale implementation of a regional mayday system. The test assessed the technical performance of the major components of the system. The primary goal of the test was to evaluate the technical, economic, and institutional feasibility of implementing a regional mayday system. A secondary goal was to determine the technical and institutional requirements and obstacles in implementing such a system.

To achieve these goals, test personnel conducted evaluations of four areas:

- System Performance — Did the system perform as designed? Did the system meet the service requirements?
- System Usability — Did users accept the system? Did users like the system?
- System Marketability — What kind of demand is there for the system? What public-private combinations of services can be economically delivered to satisfy the demand?

- Institutional Issues — Can authorities implement the system within the current institutional and social framework?

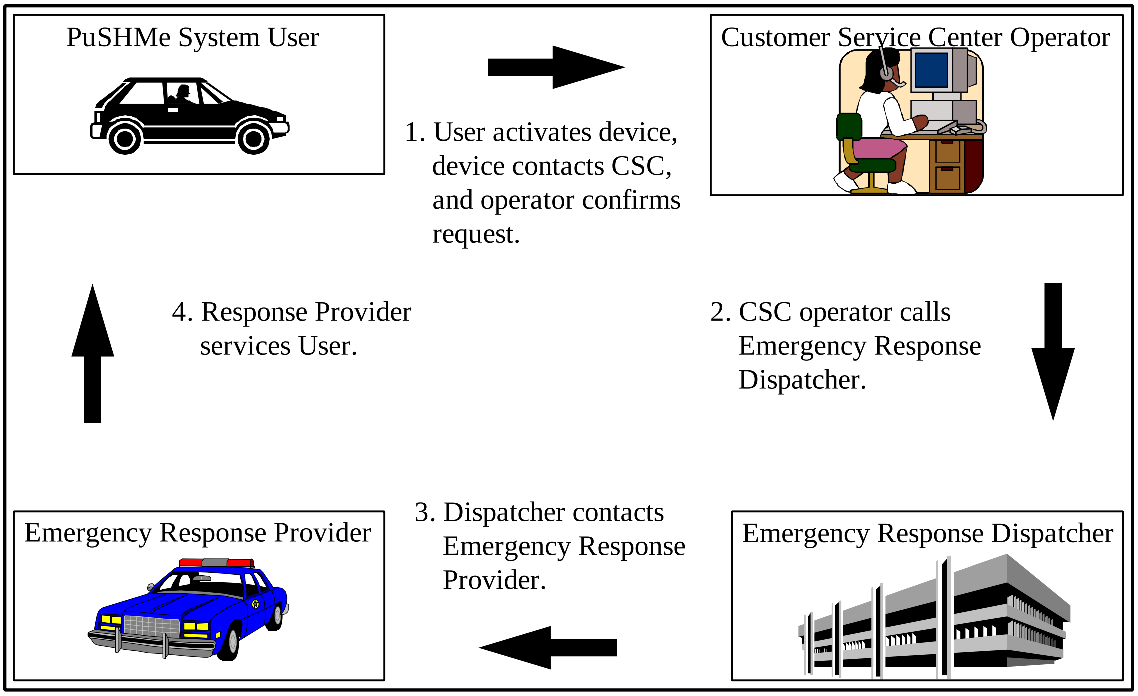


Figure 1: Overview of the Steps in Simulated Service Delivery

To answer these questions, test participants performed the technical tests and test personnel conducted surveys of participants. The participants surveyed included travelers using the in-vehicle devices as well as emergency response personnel (Service center call takers, police/fire dispatchers, etc.).

Results

The simulated nature of the test incidents affected data gathered for all aspects of the project evaluation. Response center operators knew what types of tests would occur and approximately when. The response providers also knew that they were not responding to true emergencies. The simulated nature of the test limited the test evaluator's ability to generate data that directly measured the impact of the PuSHMe system on motorist safety.

The results of the User Group Deployment test were positive. The two tested systems had an average success rate of 71 percent (88 percent for Motorola, 66 percent for XYPOINT). Test evaluators concluded that the systems could approach a 100 percent success rate. Users considered the response time rapid. Over 70 percent of the calls were verified within 2 minutes and only 13 percent required more than 5 minutes. Test evaluators also concluded that performance improved as test personnel gained experience and eliminated "bugs." They concluded that the time of day of the call did not have a great effect on the success rate or the response time.

Results from the Simulated Service Delivery test were divided according to the two systems tested. The time required to dispatch a service was about 6 minutes for the Motorola system and about 10 3/4 minutes for the XYPOINT system. The difference in the times of the two systems was due to the difference in interaction between the user and the response center operator. The Motorola system was voice-based while the XYPOINT system was text-based. Dispatchers and service providers considered that the quality of the information provided through the systems was about the same as the information they received through cellular 911 calls.

The results of the Specific Features tests differed according to the feature being tested. The results of the Dropped Carrier test demonstrate that the Motorola system was successful at re-connecting dropped calls 93 percent of the time under controlled conditions. The XYPOINT system did not have this function. The Topographic Interference test evaluated the ability of the GPS (Global Positioning System) to accurately locate the vehicle. This test showed that parking garages and "urban canyons" (in between buildings) interfered with or blocked the GPS signal and made it difficult for either system to correctly determine the vehicle's location. Both systems performed well at determining location when the terrain was open or wooded. Both PuSHMe systems were able to track a moving vehicle reasonably well in the Moving Vehicle test. In the Location test, the Motorola system was able to locate a majority (~55 percent) of the vehicles within 30 meters of the correct location. The XYPOINT system located approximately 60 percent of vehicle within 6 meters of the correct location. In the Remote CSC Operator test, Customer Service Center (CSC) Operators were able to determine the exact location of a vehicle in 60 percent of the trials and "very close" to the location in an additional 22 percent.

Users of both systems found them easy to use and felt more secure having such a system in their vehicles. The market analysis showed that purchase cost is an important factor in the marketability of the system -- functionality was a secondary consideration. The primary institutional issues surrounding the deployment of such a system involve the public/private partnership that must evolve to make such a system feasible.

Legacy

Test partners have used the information gained in the PuSHMe test in several ongoing efforts. The two commercial partners, Motorola and XYPOINT, have improved their products and plan to market them in the next year (1998). Motorola has licensed its technology to another company that will market the product in Seattle and several major cities. XYPOINT is continuing the rollout of its product in Seattle.

The Smart Trek Model Deployment Initiative (MDI) in the central Puget Sound Region has included the PuSHMe system as a component of the MDI. Smart Trek is one of four national MDIs that showcase a fully integrated Intelligent Transportation Infrastructure. The Smart Trek MDI has three primary components: information gathering and transportation management, information processing and fusion, and information distribution. The Smart Trek MDI uses PuSHMe technology as one of its information gathering components. [More information about Smart Trek is available at the website *http://weber.u.washington.edu/~trac/mdi/01a.htm*.]

Test Partners

David Evans and Associates

IBI Group

Motorola

Response Systems Partners

Sentinel Communications

University of Washington

Washington State Department of Transportation

Washington State Patrol

References

Haselkorn, M. et al, Evaluation of the PuSHMe Regional Mayday System Operational Test, Final Draft, June 1997

ITS Operational Test Summary

Real-Time Vehicle Emissions Detection (R-TED)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The R-TED ITS Field Operational Test demonstrated a prototype, field-level emissions testing system in Denver, Colorado. The test analyzed the actual tailpipe emissions of individual vehicles and displayed the results to drivers. The test intended to raise the level of awareness of motorists about emissions and air pollution. The test also intended to promote voluntary repairs or tune ups by owners to minimize harmful tailpipe emissions.

The test took place between May 1996 and August 1997.

Project Description

The test installed a Remote Sensing Device (RSD) and a variable message sign (VMS) on a freeway off-ramp leading to a major Denver arterial roadway near the center of the city. Using an active infrared emissions sensor, the RSD analyzed the emissions of vehicles exiting the freeway to determine their level of carbon monoxide (CO). As the vehicle passed the detector, a camera took an image of the vehicle's license plate. As the vehicle passed the VMS, the equipment displayed a synopsis of the analysis. The combination of the technologies was called a Remote Sensing Information System (RSIS). Figure 1 presents the RSIS configuration.

The project's purpose was to test the accuracy of the RSIS and to evaluate motorists' perceptions and responses to the system. Test partners hoped to reduce fuel consumption, increase vehicle operating efficiency, educate the public about the benefits of a well-tuned car, and encourage voluntary emissions testing and repair of "high emitting" vehicles. The test included a public relations campaign to make drivers aware of the test, a telephone hotline to answer questions, and a brochure providing information. The brochure gave suggestions for reducing vehicle emissions.

Test personnel evaluated both the technical and the behavioral components of the project. They verified the function of the RSIS, the accuracy of the measurements, and the correctness of the information displayed on the VMS. Test personnel used the license plate image to identify vehicle drivers for inclusion in telephone surveys and case studies. Test personnel conducted a telephone survey of 474 motorists whose vehicles passed through the RSIS. Using the results of the survey and the case studies, test personnel evaluated the effectiveness of the information displayed on the VMS.

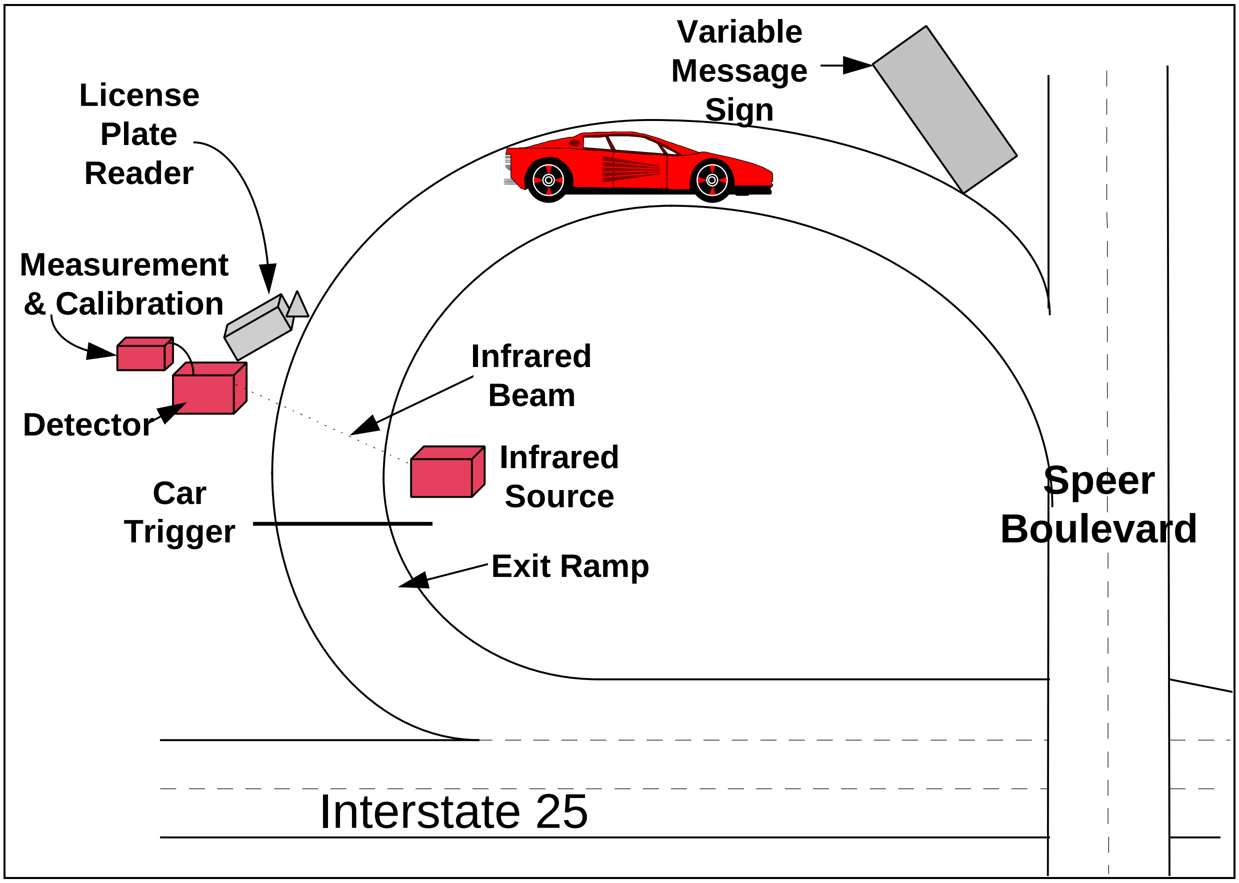


Figure 1: Real-Time Emission Detection System Physical Configuration

Evaluators made their conclusions based on:

- The RSIS technical performance. Did the system work? Were the emissions measured accurately? Was the correct information displayed?
- An assessment of motorist behavior. Did the sign's information influence the awareness, knowledge, and intentions of the motorists? Did motorists act in response to the sign's information? How much were motorists willing to pay to repair their vehicles to satisfy emissions requirements?

Results

System Technical Performance The test made these findings regarding technical performance:

- An on-board exhaust analyzer on a calibration vehicle confirmed that the RSIS accurately analyzed the emissions, except in the case of adverse weather conditions, accidents, equipment failures, or unforeseen events.
- The RSIS operated unattended over 90 percent of the time in the seven and a half months of the test. One-third of the down time occurred because contractors digging in the area severed an underground power cable. The sign subsystem accurately reported the vehicle's correct emission status.

- If one vehicle followed another too closely as they passed the detector, the RSIS invalidated the readings of both vehicles. Evaluators estimated that this caused incorrect readings for less than 0.7 percent of the vehicles, and no readings for about 1 percent of the vehicles.

Automobile User Behavior Assessment The test evaluator made the following basic findings in the behavioral assessment:

- Approximately two thirds of the telephone survey population thought the sign was informative. Respondents who received a "good" message recalled their readings better than those who received a "poor" or "fair" reading.
- Most respondents indicated that they understood the relationship between tailpipe emissions, vehicle maintenance, and fuel economy. Ninety-nine percent agreed with the statement "a well-maintained car can reduce air pollution," and eighty-three percent claimed to maintain their cars at either three- or six-month intervals. Ninety-five percent agreed that a well-maintained car saves money.
- Of the survey population, 1.6 percent reported taking some remedial action. This figure indicates that the RSIS can motivate motorists to improve the condition of their cars. The sign delivered 3 million readings to over 230,000 unique vehicles. Simple extrapolation of the survey data supports a prediction that the sign encouraged drivers to make more than 4400 voluntary repairs during the test period.
- Respondents in the "poor" stratum were more than twice as likely to act because of seeing a message on the sign as those in the "fair" and "good" strata. This is a good indication that the population most in need of the information from the sign is the one most likely to respond.
- Seventy-six percent of the survey population had a favorable impression of the sign while only five percent had an unfavorable impression. Sixty-nine percent of those who received "poor" ratings had a favorable impression of the sign. Fifty-nine percent felt that voluntary programs like the RSIS would be likely to cause people to get their cars in better operating condition while only thirty-two percent thought it unlikely. Among the case study population, most of those with "good" readings said they would fix their cars if they received a "fair" or "poor" reading.

Legacy

Operation of the system concluded after the test was completed. Discussions are taking place to determine several possible follow on scenarios, including:

- Finding additional funding to resume operation of the RSIS at the current location
- Moving the RSIS (pending funds availability)
- Mounting the sign on a trailer to make the whole system portable so motorists outside the Denver metropolitan area could benefit.

Test Partners

Colorado Department of Public Health and the Environment

Colorado Department of Transportation

Conoco

Federal Highway Administration

Remote Sensing Technology

Skyline Products, Inc.

University of Denver

References

National Center for Vehicle Emissions Control and Safety, Colorado State University, ITS For Voluntary Emissions Reduction — An ITS Operational Test for Real-Time Vehicle Emissions Detection, May 1997

Lacey, N., Bohren, L., and Hutton, R. B.; "Clearing the Air," *ITS World*, Sept/Oct 1997, pg 42-44

ITS Field Operational Test Summary

San Diego Smart Call Box

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The San Diego Smart Call Box ITS Field Operational Test evaluated the feasibility and cost effectiveness of using enhanced roadside call boxes for data collection, processing, and transmission. Smart Call Boxes are an improved version of devices used as emergency call boxes in California. The test examined using the smart boxes for traffic census data collection, incident detection, hazardous weather reporting, changeable message sign (CMS) control, and video (CCTV) surveillance. The evaluation focused on cost effectiveness compared to other methods.

The test had two goals:

- Evaluate the cost effectiveness of smart call boxes
- Document and discuss the institutional issues encountered.

The tests were conducted at numerous sites on the interstate and state highway system of San Diego County, California (see Figure 1). The test took place from September 1995 to June 1996.

Project Description

To improve motorist safety and emergency response, CalTrans (the California Department of Transportation) has installed an emergency phone system (call boxes) along many of the highways in the state. Motorists can use these phones, located at regular intervals, to connect directly to emergency dispatch centers. This Field Operational Test explored the possibility of using the established call box infrastructure to gather and transmit additional traffic and weather information.

The test planned to conduct five subtests, one for each data processing and transmission task. The project actually tested functional systems for traffic census data collection, hazardous weather reporting, and CCTV surveillance. Test partners canceled the changeable message sign subtest when the tested call box system proved incompatible with the California CMSs. The installed incident detection systems did not function properly.

The information collected by the call box installations was transmitted to the CalTrans District 11 Transportation Management Center.

The test had several objectives related to the project goals. Test evaluators attempted to determine the relative effectiveness of smart call boxes compared to a baseline system of conventional telephone lines and controllers. They also wanted to determine the projected life-cycle costs of the two systems and the tradeoffs between the systems. The ultimate objective was to determine which system is best for each task. The evaluators attempted to determine whether any institutional issues encountered have the potential for affecting the performance of similar systems.

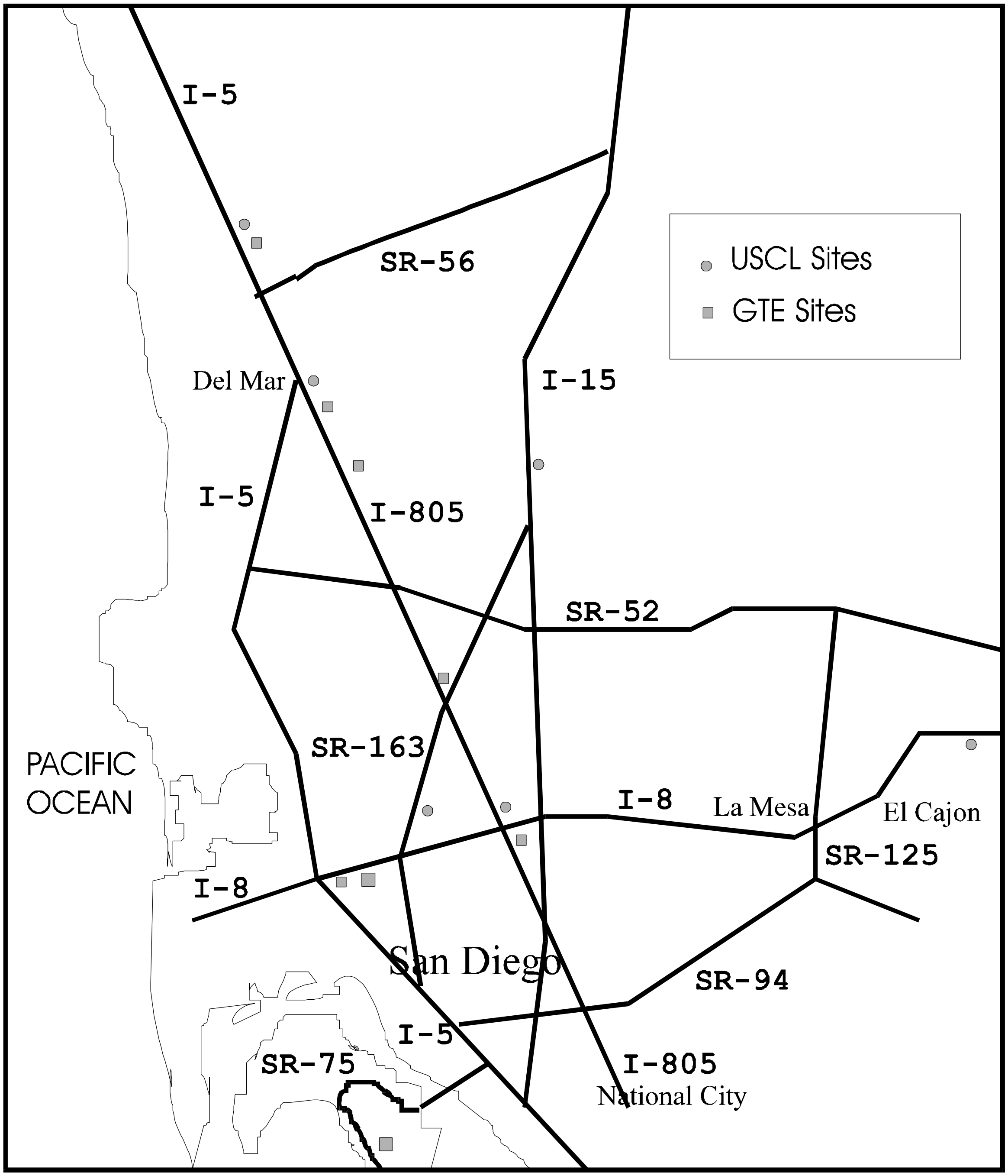


Figure 1: Smart Call Box Field Test Sites

Results:

The evaluation found the smart call box concept to be feasible but not necessarily optimal. Smart call box systems will often be cheaper to deploy than hardwired systems. Smart call box systems, however, did not necessarily prove to be superior to other wireless systems.

The planned tests encountered problems. Most test equipment experienced varying periods of three conditions: operational, operational with problems, and non-operational. Test personnel were not able to control changeable message signs using the tested call box system because the CMSs used in California proved incompatible. Therefore, Test personnel canceled the CMS subtest. Test personnel installed call box-based incident detection systems but these systems did not function properly. In the video (CCTV) subtest, the installed system could not remotely control the pan-tilt-zoom capabilities because of communication and system integration problems.

Test personnel encountered significant system integration problems. The design of portions of the system to be located at the TMC was considered to be outside the scope of the test. Therefore, test personnel made use of existing data collection components or used the simplest possible means. Problems also arose because the call boxes (owned and operated by the partners) ran software provided by the vendors. Evaluators were not sure if some data integration problems resulted from basic incompatibilities or from the project staff's lack of familiarity with the software. These problems led to reduced usefulness of some of the data or delays in integration of the field data with the TMC data.

For the three successful subtests, evaluators estimated cost savings. Evaluators noted that using Smart Call Boxes to control field devices in the three successful tests could result in substantial per site savings over other alternative control options. The possible capital cost savings ranged from about $1,500 to as much as $103,000.

Evaluators noted several institutional issues that need to be resolved prior to full-scale deployment of smart call box systems. Future systems must be rigorously tested and include design enhancements, improved reliability, and lower maintenance costs. Any agency considering deployment of such a system should prepare detailed deployment plans. The agency should also resolve other important issues, such as ownership, financing, and maintenance. Evaluators also cited inadequate involvement of the partner agencies and the potential users of the system in the development of system designs. The organizational structure of the test partnership and the cumbersome contracting procedures of the partners resulted in major delays that had a negative effect on the outcome of the subtests. Evaluators suggested that the project manager and the vendors be included as partners to overcome some of these problems.

Legacy

The results of this test led to a decision to prepare a proposal for pilot deployment of a small scale smart call box system in the San Diego area. The deployment would install systems to collect traffic census data, detect low visibility conditions, monitor wind speed, and verify CMS messages by CCTV. The deployment plan would provide for further testing and system development.

Other smart call box projects are currently in progress in California. In the San Bernadino-Riverside area, call box systems are monitoring traffic census data and weather conditions. In Sutter County, systems are collecting traffic census data and detecting low visibility conditions.

Test Partners

California Department of Transportation

California Highway Patrol

Federal Highway Administration

San Diego Service Authority for Freeway Emergencies

San Diego State University

References

Banks, J. H., and P. Powell, Smart Call Box Field Operational Test Evaluation, Summary Report, May 1997.

ITS Operational Test Summary

Seattle Wide-Area Information For Travelers

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Seattle Wide-Area Information For Travelers (SWIFT) ITS Field Operational Test evaluated the performance of a large-scale, urban Advanced Traveler Information System (ATIS) deployment in Seattle, Washington. The SWIFT ATIS had several unique features. Among these were the provision of information for multiple transportation modes, the delivery of this information using three different devices, and the use of FM sideband as the primary communications medium.

Testing of the system took place from August 1996 to September 1997. The Evaluation Report will be ready in July 1998.

Project Description

The Seattle Wide Information For Travelers Project tested the ability of a high speed FM subcarrier to deliver traveler information to users via a paging watch, a lap top computer, and an in-vehicle navigation device. Figure 1 shows the SWIFT components and the flow of information between them.

The system used the existing infrastructure to capture traveler information. Washington Department of Transportation's freeway management system provided information pertaining to freeway conditions. King County Metro in Seattle provided bus locations. Traffic incidents were encoded then sent to the in-vehicle navigation device, which announced incidents through the car radio system. The system also sent traffic information to lap top computers, which in turn, plotted incidents on a map data base and displayed them on the screen. The Message Watch alerted the commuter to problems for routes and times that the user specified in an individual travel profile.

Additional features of the delivery systems consisted of the following. The in-vehicle navigational system included a yellow page directory of local landmarks, hotels, and restaurants with GPS to show location and relative direction to the selected destination. The PC notebook computer displayed graphical maps with incident icons and showing details such as incident type, roadway affected, and direction. The system also provided bus schedules and locations and ride share matching information.

The SWIFT evaluation examined the system architecture, communications coverage, institutional issues, deployment costs and user acceptance.

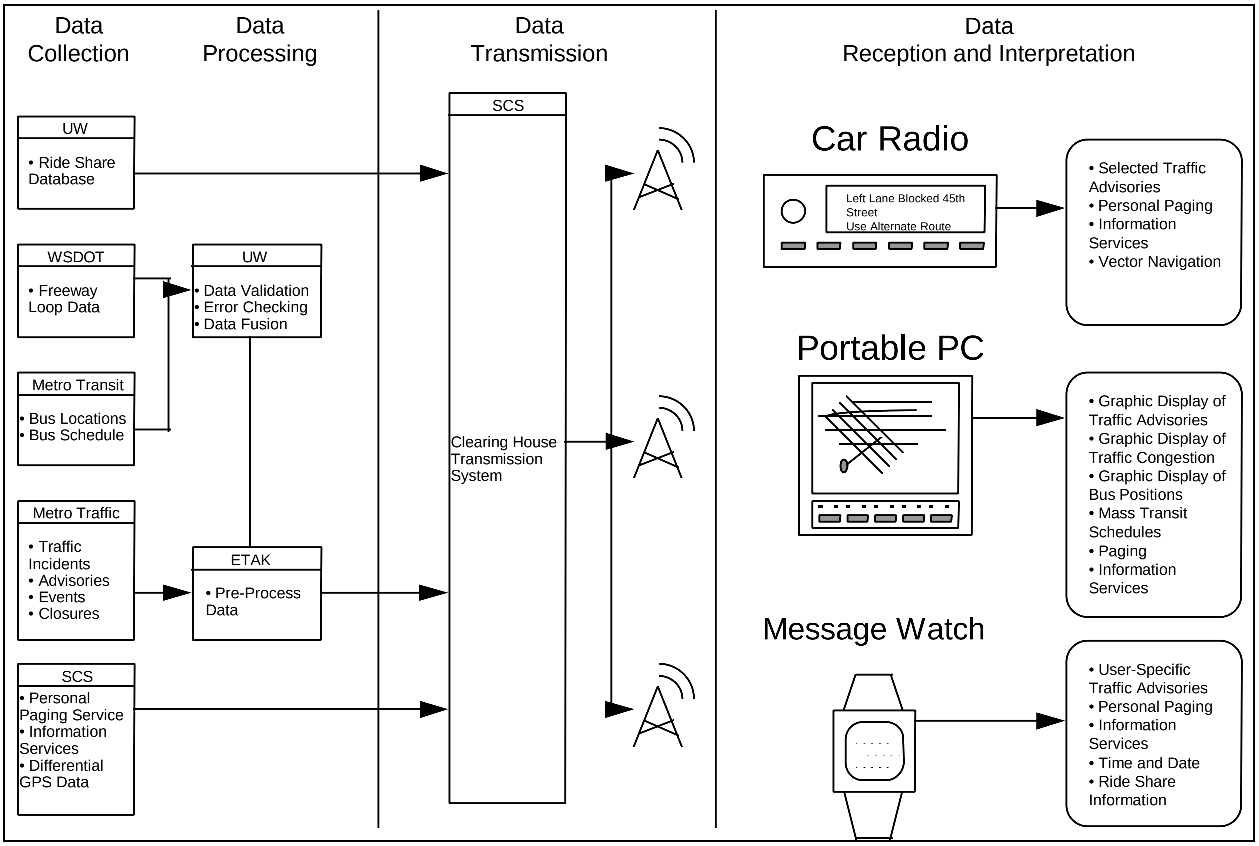


Figure 1: SWIFT Components and Data Flow

Test Status

SWIFT testing concluded in September 1997. The final evaluation report is due in July 1998.

A draft report about the institutional issues gave some evaluation results. The institutional issues that primarily affected the SWIFT project were:

- Responsibilities - Some SWIFT team members ended up performing activities that were outside of, or in addition to, their expectations when they started the project.
- Role Clarity - Differing expectations regarding the role and responsibilities of each organization in the SWIFT teaming agreement caused some development, testing and deployment delays.
- Public/Private Partnership - Confusion as to the exact role of public and private agencies in a public/private partnership caused delays in contract negotiations.
- Patent/Copyrights - Concerns about how patent and copy rights should be assigned to the SWIFT team members in the public/private partnership caused additional delays and or re-negotiation of SWIFT contracts.
- User Perception/Acceptance - Because user inputs and prototyping were minimal during the design phase, concern was expressed about how well the SWIFT system would be accepted by end users or operational test participants.

The primary SWIFT lessons learned were:

- ITS partners need to be both capable and committed to doing the work
- Each side of the public/private partnership needs to understand the principles and ideals that govern the other
- There needs to be team-member consensus regarding the development approach and the technical tools to be used
- Federal Accounting Regulations (FARs) need to be changed to include models for public/private partnerships that address the distribution of patent and copy rights among the team members
- Market research, user-system prototyping and user training should be included in ITS projects to ensure that the system is well received

One of the test partners, Seiko Communications System is continuing to transmit pre-trip and en-route traveler information, en-route transit information, traveler services information, and ride matching and reservation services, through the Seiko Message Watch.

Test Partners

Delco Electronics

ETAK

IBM

Metro Traffic

Seiko Communications Systems (SCS)

University of Washington

SAIC

References

Washington State Department of Transportation -Transportation Research Center, SWIFT Institutional Issues Study Final Report- Draft, December 1997

Dailey, Daniel J. and Haselkorn, Mark P., SWIFT: Technical and Institutional Issues of an Operational Test from a Public Sector Perspective

ITS Operational Test Summary

Southwest Electronic One-Stop Shopping

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Electronic One-Stop Shopping (EOSS) ITS Field Operational Test was a Commercial Vehicle Operations (CVO) test that demonstrated the technology and process necessary to automate and integrate common motor carrier administrative functions across three states. The test evaluated a system to electronically apply for and receive commercial vehicle credentials. Using the EOSS, a motor carrier could electronically apply for and receive vehicle registration under the International Registration Plan (IRP), register to pay fuel taxes under the International Fuel Tax Agreement (IFTA), and register for Single State Registration (SSR).

The testing and data collection occurred from August 1996 to April 1997 in Colorado, Arkansas, and Texas. The evaluation of the test focused on the performance of the EOSS system, on determining the changes in productivity and user perceptions, and on documenting the institutional issues.

Project Description

The EOSS system provided a user-friendly, graphical computer system that could identify the required commercial vehicle credentials and facilitate their issuance. Industry and state agency users could access the system using a personal computer. The system included two functional modules -- the Information Module and the Credentials Module. The Information Module allowed users to determine what credentials each state required. The Credential Module allowed users to apply for, pay for, receive, and print credentials. Figure 1 shows the EOSS system process.

To use the system, a motor carrier user completed a credential application on a computer running the EOSS software. The software was designed to facilitate user data entry and interaction with the EOSS. The software aided the completion of the form by eliminating re-entry of the same information on different applications and verifying some of the information entered on the application. The user could submit the completed application to the state regulatory agency either electronically (over a value added network -- VAN), by fax, by mail, or by hand carry.

If submitted electronically, the user accompanied the application with electronic funds transfer instructions. If the application met specified criteria, the system would issue a temporary credential (permanent in the case of SSR). The system could immediately print the credential at the carrier's printer or could fax it to a number specified by the carrier.

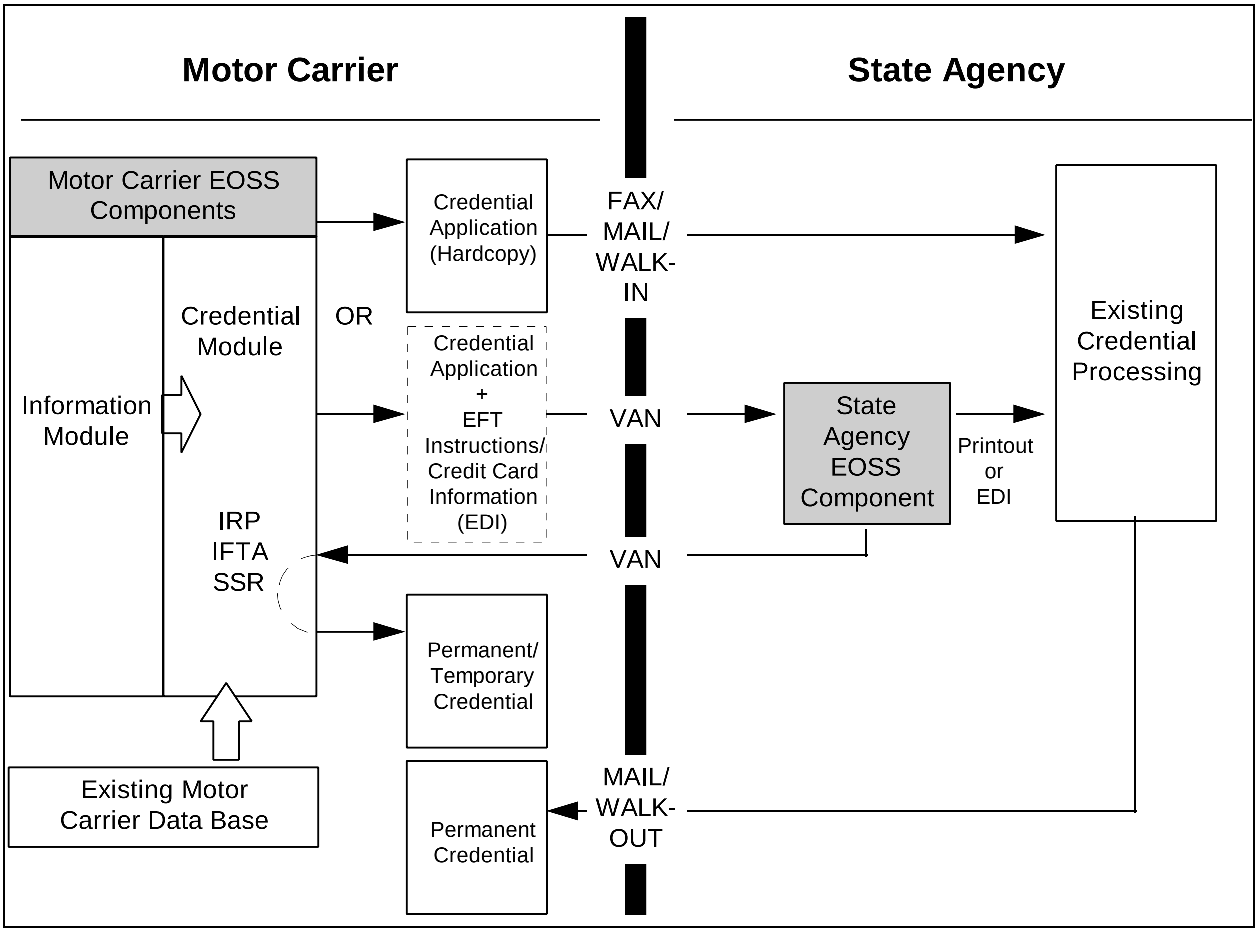


Figure 1: EOSS System Process

The state regulatory agency responsible for issuing permanent credentials processed the application in the standard manner. In Texas the agency was able to transfer the application information electronically to their database for processing.

The test consisted of two evaluations: one for the private sector motor carriers and the other for the public sector state regulatory agencies. In the evaluations, test personnel examined the changes in productivity and in user perceptions caused by the use of the EOSS. They also assessed the requirements and potential for EOSS deployment. They documented and assessed the significant institutional issues that the test encountered. In addition, test evaluators determined the suitability of the system (whether the system is appropriate for the situation) and evaluated the system's performance.

Results

The draft Evaluation Report, due in March 1998, summarizes the two Final Test Reports (motor carrier and state agency).

Results from the motor carrier evaluation showed uniformly positive opinions about the EOSS. All participating carriers considered the EOSS system to be a significant improvement compared to the current methods of obtaining credentials. These carriers cited improvements in productivity as one of the benefits. The greatest benefit that carriers cited was the time saved by applying for and obtaining the credentials electronically. Other benefits mentioned by the carriers included increased accuracy, convenience, reduced redundancy, ease of learning, and ease of use. Carriers expressed some concern over the possible development of multiple, incompatible credential systems and expressed a preference for uniformity among states. Carriers are also concerned about the system that would be required for the electronic payment of fees.

Results from the state agency evaluation indicate that the states currently have only a small incentive to use the EOSS system. States processed the applications for permanent credentials in the same manner regardless of whether they were submitted by hand or electronically. If the EOSS system can be electronically integrated with the state regulatory authority's documentation and filing process, productivity benefits would accrue to the states as reduced duplication and input time and increased accuracy.

Significant institutional barriers arose during the test process. Many of the agreements used to allow the test to run were temporary. It may not be possible to create long-term agreements similar to these temporary arrangements. The roots of many barriers or issues are found in various state regulatory procedures that may be administrative, statutory, or even constitutional in nature. Resolving these barriers or issues may require legislative or political action.

Legacy

Colorado and Texas left the system in place after official sponsorship had ended. These two states allowed those carriers already participating in the project to continue to use it. Carriers, however, made little use of the system after the Operational Test period ended and neither state made it available to additional carriers. Both Texas and Colorado are actively exploring electronic credentialling, with the Southwest EOSS system being one option.

Arkansas did not continue use of the system after the operational test period ended and is not actively pursuing electronic credentialling.

The commercial parties responsible for the development of Southwest EOSS, In Motion, Inc. and Intelligent Decision Technologies, Inc., are continuing to develop and refine electronic credentialling systems.

Test Partners

Arkansas Highway and Transportation department

Arkansas Motor Fuel Tax section

Arkansas Office of Motor Vehicles/IRP Unit

Arkansas State University

Booz•Allen & Hamilton, Inc.

Colorado Department of Regulatory Services

Colorado Department of Revenue

Colorado Department of Transportation

Federal Highway Administration

Fifteen motor carriers and two credential processing agents

In Motion, Inc.

Texas Department of Transportation

References

Arkansas State University Transportation Management Program, Southwest EOSS Motor Carrier Test Report, December 1997

Arkansas State University Transportation Management Program, Southwest EOSS State Agency Test Report, December 1997

ITS Operational Test Summary

Spread Spectrum Radio Traffic Signal

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Spread Spectrum ITS Field Operational Test investigates the feasibility of using spread spectrum radio (SSR) to control a traffic signal system. The test assesses the use of this technology as an alternative to conventional copper wire interconnect. The test has two purposes:

- Examine whether SSR is a reliable means of communicating in a metropolitan area
- Assess the cost savings that may occur through use of SSR.

The test is taking place in the City of Los Angeles, Los Angeles County, California. Field testing of the radio interconnect component began in January 1998. The Final Report is expected in March 1998.

Project Description

SSR is a form of wireless communication that offers the potential to rapidly communicate with any traffic signal intersection from a central location without the extensive trenching and cabling normally associated with such activity. If SSR can demonstrate a level of reliable data transmission equal or superior to that normally achieved with copper wire interconnect, the potential for cost saving in the installation of the system is high. In Los Angeles, SSR transmits in the 900 MHz band. Other unlicensed SSR bands exist at higher frequencies. These higher frequencies are generally less congested but have smaller ranges for a given power output.

Using the 900 MHz band may present interference problems for the SSR. The 900 MHz application is authorized by the Federal Communications Commission under Part 15 of its rules and regulations governing radio frequency (RF) transmission. The 900 MHz band is unlicensed and does not enjoy protection from interference that licensed users enjoy. One important consequence of using the 902 to 928 MHz band is that there is no control on the number and type of users. Other users of this band typically include paging services, cordless telephones, garage door openers, remote access or control of utility company assets, stolen vehicle recovery services, and hotel room key locking systems. Incidental, out-of-band RF radiation from Federal Aviation Authority, Department of Defense, and weather radar applications may also pose potential interference problems for critical applications in this 900 MHz band.

The test has deployed approximately 100 SSR radios in the West of Los Angeles, in and around Marina Del Ray and Culver City. The radios are distributed, generally equally, in four signal networks, each of which has a “headend” radio and several “tailend” radios. Each of the radios is hard-wire connected to a traffic signal controller. The headend radio communicates with the tailend radios in the network using the spread spectrum radio traffic signal interconnect (RTI). Figure 1 shows a schematic view of the system.

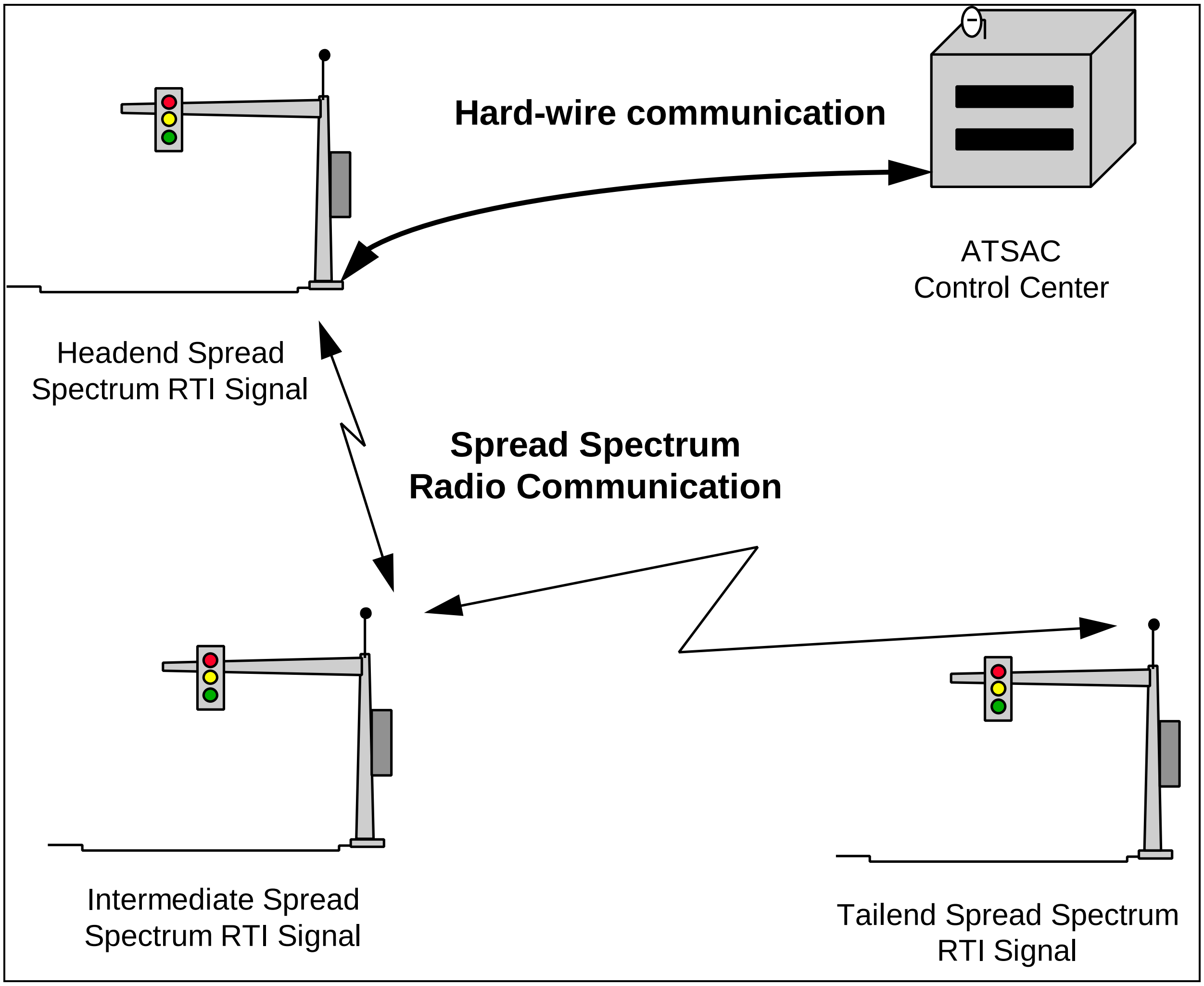


Figure 1: Schematic of Spread Spectrum System

The headend radio is connected via hardwire to the Los Angeles traffic control system, located at the Advanced Traffic Surveillance And Control (ATSAC) center in downtown Los Angeles. The ATSAC sends traffic signal control messages to the headend radio. The headend radio passes these messages to the appropriate tailend radio, using intermediate radios, if necessary. Each tailend radio communicates the messages to its corresponding traffic signal controller. A traffic signal controller passes messages to its corresponding radio that then relays the message to the headend radio via other intermediate radios. The headend radio passes these messages to the ATSAC. The test is assessing the performance of SSR under a range of traffic, weather, and installation scenarios.

SSR will be evaluated in two ways:

- Evaluating the technical details of system performance, specifically focusing on the quality of communications between radios
- Documenting practical lessons, focusing on cost effectiveness, time effectiveness, and transferability issues.

Test Status

The Spread Spectrum project began in 1994. The design tasks lasted until early 1996. Software implementation started in late 1995 and is continuing. Evaluation of the project began in mid 1995 and also continues. Actual traffic signal control will commence in January 1998. The Final Report is due in March 1998. No interim results are available.

Test Partners

California Department of Transportation

City of Los Angeles

Federal Highway Administration

Hughes (SSR)

Transcore (ATSAC/UTCS interface)

References

None published.

ITS Operational Test Summary

Texas Regional International Border Crossing System

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Texas Regional International Border Crossing System (TRIBEX) ITS Field Operational Test demonstrates the use of ITS technologies as a means of reducing the delays incurred by users of three international border crossings. The goal is to enable commercial vehicles to cross a "transparent" international border. The main objective is to provide an accredited service to both the border officials and agencies and bridge users that allows pre-processed vehicles, drivers, and cargo to more quickly pass through international border check points.

The test takes place at three border crossings between the US and Mexico. The crossings are the Lincoln-Juarez Bridge between El Paso, Texas, and Juarez, Mexico, and the Columbia-Solidarity and Ysleta-Zaragosa bridges between Laredo Texas and Nuevo Laredo, Mexico. The test operations will begin in February 1998. Inclusive dates for the terms of operation and evaluation have not yet been determined.

Project Description

The international trade community and government officials responsible for customs, immigration, and transportation, must execute a complex set of transactions and inspections in order for vehicles, drivers, and cargo to cross legally and safely from one country into another. Because a large portion of these transactions is conducted manually, the time required to process an individual shipment can be significant. At land border ports such as these three international bridges, commercial vehicle traffic volume has grown to the point where lengthy processing delays are commonplace. These delays impact the trade community by increasing costs, and adversely affecting the efficiency of operations. The increasing volume of commercial vehicles has also led to lengthy traffic queues along the bridge spans, causing delays and presenting potential safety hazards. As part of the IBC (International Border Clearance) Program, FHWA has worked with representatives from the Texas Department of Transportation, the bridge authorities, the US Treasury's North American Trade Automation Prototype (NATAP) program, and Mexican transportation officials, to cooperatively address these issues.

The IBC program has developed a system design and architecture. This design and architecture aims to significantly reduce administrative delays incurred by vehicles at international points of entry. The system also facilitates the safety screening of commercial vehicles. The TRIBEX system will facilitate vehicle processing using dedicated short-range communications (DSRC) for trade and transport related commercial vehicle electronic screening. The end goal is to replace current paper-based processes with ones supported by electronic data interchange (EDI). The TRIBEX system will address the safety of commercial vehicles operating in the State of Texas, and throughout the US, by forwarding transport safety data obtained by the system to an existing commercial vehicle weight and inspection facility. This data will be in a format consistent with those under development under the Commercial Vehicle Information Systems and Networks

(CVISN) program, and will allow the Texas Department of Public Safety to effectively screen incoming vehicles for safety compliance.

The system's operation is largely automatic. The system polls transponders installed in approaching vehicles, and uses stored information to support the exchange of information between the trade community and regulatory agencies responsible for customs, immigration and transportation. Figure 1 shows the TRIBEX system overview.

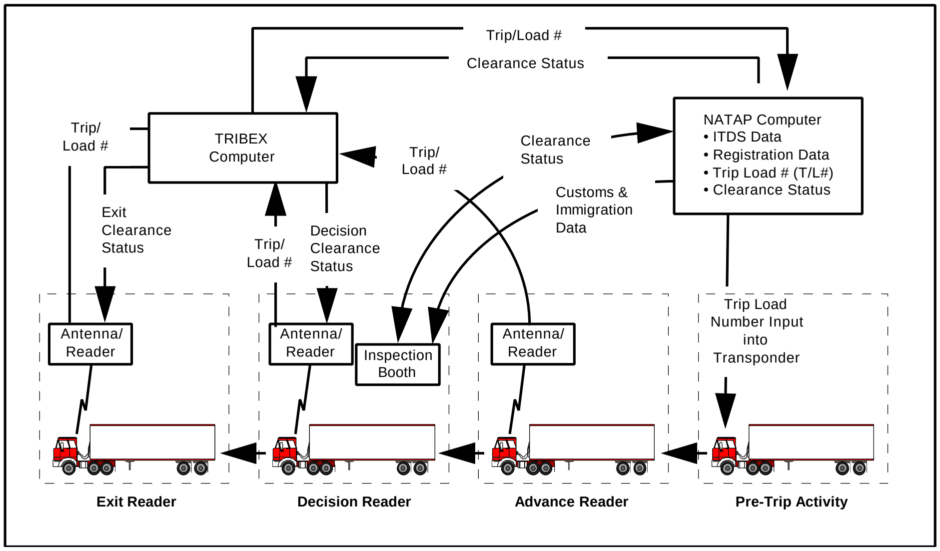


Figure 1: The TRIBEX System Overview

As an enrolled vehicle passes the *advance* reader location at the approach to the border crossing and inspection/processing compound, the TRIBEX system electronically screens it using DSRC. The system reads carrier, vehicle and cargo identification data, as a trip/load number, from a transponder installed in the vehicle cab. TRIBEX forwards this information through the Traffic Facility Integrated Communications (TRAFIC) system to the NATAP system.

When the vehicle reaches the US Customs primary inspection point, the *decision* reader reads the transponder a second time. This action again prompts the TRAFIC system to forward the trip/load number to the NATAP system. The NATAP system displays selected information in the customs primary inspection booth. The NATAP information consists of immigration, transportation, and trade related documentation regarding the status of the carrier, driver and cargo. Considering the information provided, customs inspectors instruct the driver to proceed to the compound exit, to a secondary (more detailed) inspection, or to a state roadside inspection facility. The customs inspectors relay these instructions to the driver via a red or green signal displayed both on the transponder and on a traffic signal adjacent to the primary inspection booth. The system reads the transponder a third and final time as the vehicle reaches the exit of the compound. If the vehicle has completed all inspections satisfactorily, and has all required documentation in order, the system gives the driver a green light to exit the compound.

The evaluation of this operational test has not yet been defined.

Test Status

System operations are scheduled to begin in February 1998, and continue for a period to be determined.

Test Partners

City of Laredo, Texas

City of El Paso, Texas

Federal Highway Administration

Lockheed-Martin IMS

Signal Processing Systems, Inc.

Texas Department of Public Safety

Texas Department of Transportation

References

None published

ITS Field Operational Test Summary

TransCal Interregional Traveler Information System

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The TransCal ITS Field Operational Test evaluates an Interregional Traveler Information System (IRTIS). The IRTIS provides coverage for the Interstate 80 and US 50 corridor between San Francisco and Tahoe/Reno-Sparks area. The IRTIS proposed to disseminate customized traveler information via telephone, personal digital assistants (PDAs), and in-vehicle navigation devices (IVDs) as well as traditional broadcast media. The primary objective of TransCal is to disseminate comprehensive, accurate, and timely pre-trip and en route traveler information to help mitigate the impacts of congestion and incidents.

The Traveler Advisory Telephone System (TATS) component of the TransCal field operational test (FOT) became unofficially operational in March 1997 and will continue until September 1998. Testing of the PDAs and IVDs continues until March 1998. The Final Evaluation Report is expected in March 1999.

Project Description

TransCal implements a comprehensive interregional traveler information system that integrates road, traffic, transit, weather, and value-added traveler services from various sources. The project demonstrates the utility of an advanced traveler information system and showcases emerging capabilities in computing, communications, and consumer electronics. Figure 1 shows the area of IRTIS operation during the field operational test.

TransCal originally included two other components. These components were an emergency notification system to test a satellite-based two-way communication system, and a Tahoe transit frequent passenger program to increase transit use in the Lake Tahoe Basin. TransCal's Management Board, however, voted to eliminate these components from the project and redirected the funds in support of the IRTIS component.

The IRTIS operates from the TransCal Traveler Information Center in Sacramento, California. It receives real-time traveler related information from existing public and private interregional sources. It processes and fuses this data with existing static and periodic data and maintains a real-time traveler information database. The system disseminates the information to travelers via wireline and cellular telephones and FM subcarrier networks. The general public can access this information via telephone and traditional broadcast media. Test personnel are evaluating accessing the information using PDAs and IVDs. The paragraphs below briefly describe these devices.

- **Personal Digital Assistants (PDAs)** - The PDAs are hand-held, portable devices that provide users with information contained in the IRTIS database. The PDAs receive dynamic information types through the FM subcarrier data broadcast system.

- **In-Vehicle Devices (IVDs) –** The IVDs provide interactive access to detailed maps and the use of an integrated GPS receiver to determine the vehicle's current location. The IVDs receive dynamic information types through the FM subcarrier data broadcast system.

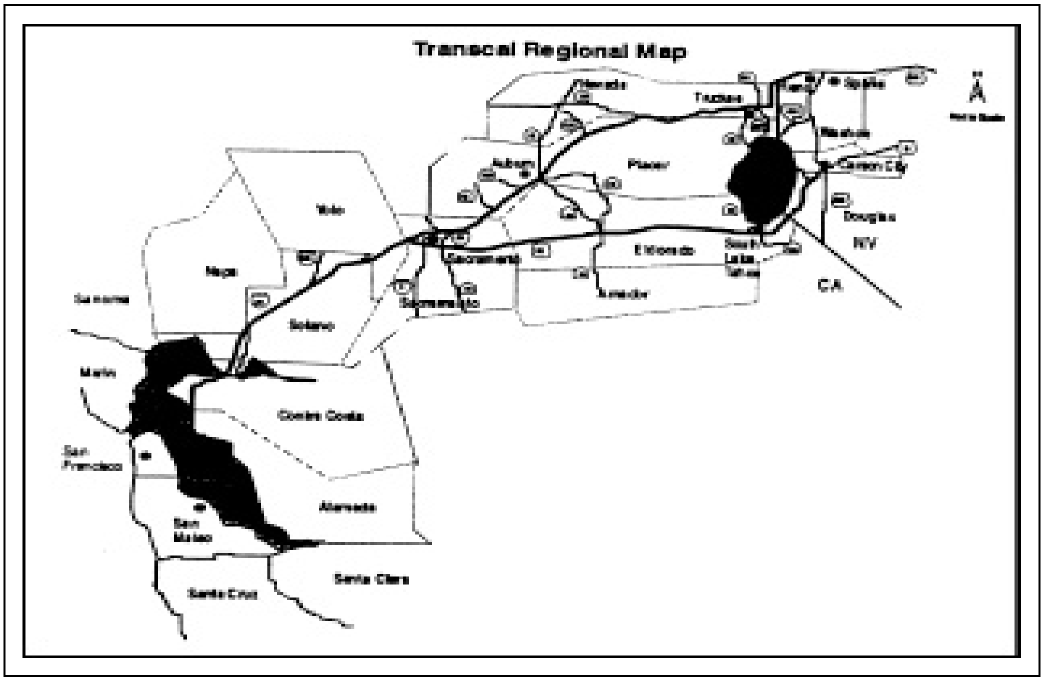


Figure 1: IRTIS Operational Test Area

The IRTIS uses three types of data definitions: static, periodic, and dynamic. Static data remains relatively constant over time and for the duration of the test. Periodic data remains relatively constant for short periods of time — on the order of weeks. Dynamic data consists of current conditions obtained as they occur. Static data may reside in the IRTIS database or within the dissemination devices themselves. Periodic and dynamic data is processed and maintained by the IRTIS computer workstations in real-time. Table 1 provides a list of data types within each data category.

Static Data Definition	Periodic Data Definition	Dynamic Data Definition
• Freeway segment definitions • Arterial segment definitions • Transit segment definitions • Transit stop locations • Major points of interest • Transit route definitions	• Transit schedule • Transit fares • Planned lane closures • Planned detours • Planned events • Airline phone numbers	• Freeway incidents • Arterial incidents • Transit incidents • Transit schedule change • Emergency maintenance • Planned event status • Regional weather status

Table 1: IRTIS Data Definitions

IRTIS consists of a data processing subsystem (IRTIS main database), a data dissemination system, and multiple end-user technologies designed to receive data from the IRTIS main database.

The data processing subsystem combines data from multiple sources to produce an integrated list of freeway and arterial incidents, emergency maintenance, planned event status, and regional weather status. The subsystem also determines the initial status of new traffic incidents and updates the current incident list as appropriate. The data processing done by the IRTIS uses the TRW Trans View advanced traveler information software. This software supports the collection, processing, and dissemination of real-time traffic and transit information. The data processing subsystem consists of computer workstations and servers on a local area network that is scaleable in size to accommodate any number of inputs and outputs. The network connects to a wide range of traveler services and products. A separate computer server acquires, processes, maintains, and disseminates the information.

The IRTIS automates the data collection process as much as possible. An IRTIS operator, however, must manually input data from some data sources. An IRTIS operator is also responsible for keeping traveler information accessible via public telephone through a voice processing system called the Traveler Advisory Telephone System. The operator makes a voice recording of any changes in traveler information based on reported changes of the current traveler information database. Travelers can access this information by calling a single telephone number.

The evaluation goals of the TransCal project include:

- Assess user acceptance from the perspective of the end-users, public partners, and private partners
- Assess benefits and costs of IRTIS
- Assess system performance of IRTIS as an integrated system and by system component
- Assess IRTIS impact on travel behavior
- Assess institutional and legal issues

Test Status

After beginning operation of the TATS component, issues pertaining to the in-vehicle device performance and proposed kiosk database quality delayed a full conduct of the test. In February 1998, the test partners decided to end test operations. The partners will finish testing the PDAs and IVDs by the end of March 1998. The TATS will remain operational until September 1998 using state funds. The test will redirect the existing evaluation efforts to focus on capturing the institutional and technical lessons learned during the course of the test. The evaluator will prepare a final report by the end of March 1999.

Test Partners

California Department of Transportation

California Highway Patrol (CHP)

Federal Highway Administration

Metropolitan Transportation Commission (MTC)

Nevada Department of Transportation

Nevada Highway Patrol (NHP)

RTCWC

Sacramento Council of Government (SACOG)

Sierra Counties Consortium

Tahoe Trans District

TRW

References

None published.

ITS Field Operational Test Summary

TRANSCOM System for Monitoring Incidents and Traffic (TRANSMIT)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The TRANSCOM System for Monitoring Incidents and Traffic (TRANSMIT) ITS Field Operational Test provided travel time information and remote incident detection on twelve miles of the New York State Thruway (NYST) and seven miles of the Garden State Parkway (GSP). The TRANSMIT test assessed the feasibility of using existing electronic toll collection (ETC) equipment to facilitate traffic surveillance and incident detection. TRANSMIT collected this information by capturing and analyzing successive reads of existing ETC transponders to determine traffic flow characteristics.

The Transportation Operations Coordinating Committee (TRANSCOM) is a coalition of fourteen highway, transit, and public safety agencies in the New York/New Jersey/Connecticut area. The Committee has become a major repository and purveyor of region-wide transportation data. TRANSCOM deployed the TRANSMIT system between early 1995 and mid 1996. The system continues to operate at this time. The evaluation of the test included an analysis of the data communication, the system's incident detection capabilities, its traffic parameters estimation capability, and the system costs and benefits.

Project Description

TRANSMIT uses existing ETC equipment to provide traffic speed and incident detection information to TRANSCOM's Operations Center. The existing ETC system in the New York area allows motorists to obtain and install electronic transponders on their vehicles. As the vehicle approaches a toll facility (thruway toll plaza, bridge, or tunnel), equipment at the facility reads the transponder identification signal and debits the motorist's account for the amount of the toll. On the New York State Thruway west of the Tappan Zee Bridge, as many as 3,500 vehicles per hour use the existing ETC. On the Garden State Parkway, over 250 vehicles per hour have been detected, even though the Parkway does not yet support ETC.

TRANSMIT used the same ETC technology to track vehicles along the roadway and to calculate traffic speed. On 19 miles of roadway approaching New York City, TRANSMIT installed 22 transponder readers at roughly 1.5-mile intervals in both travel directions. As a transponder-equipped vehicle passed one of the overhead antennas, the system read the vehicle's identification signal. The system recorded the identification number and arrival time of the vehicle. Included in the system was a privacy feature that encrypted the vehicle identification signal to prevent its unauthorized use. The system transmitted the number and time information of each vehicle to TRANSCOM headquarters over a leased telephone service (except at the Tappen Zee Bridge where a spread spectrum radio link was used). As the vehicle continued along the highway, it passed additional transponder readers that repeated the process. Figure 1 presents a schematic of the system.

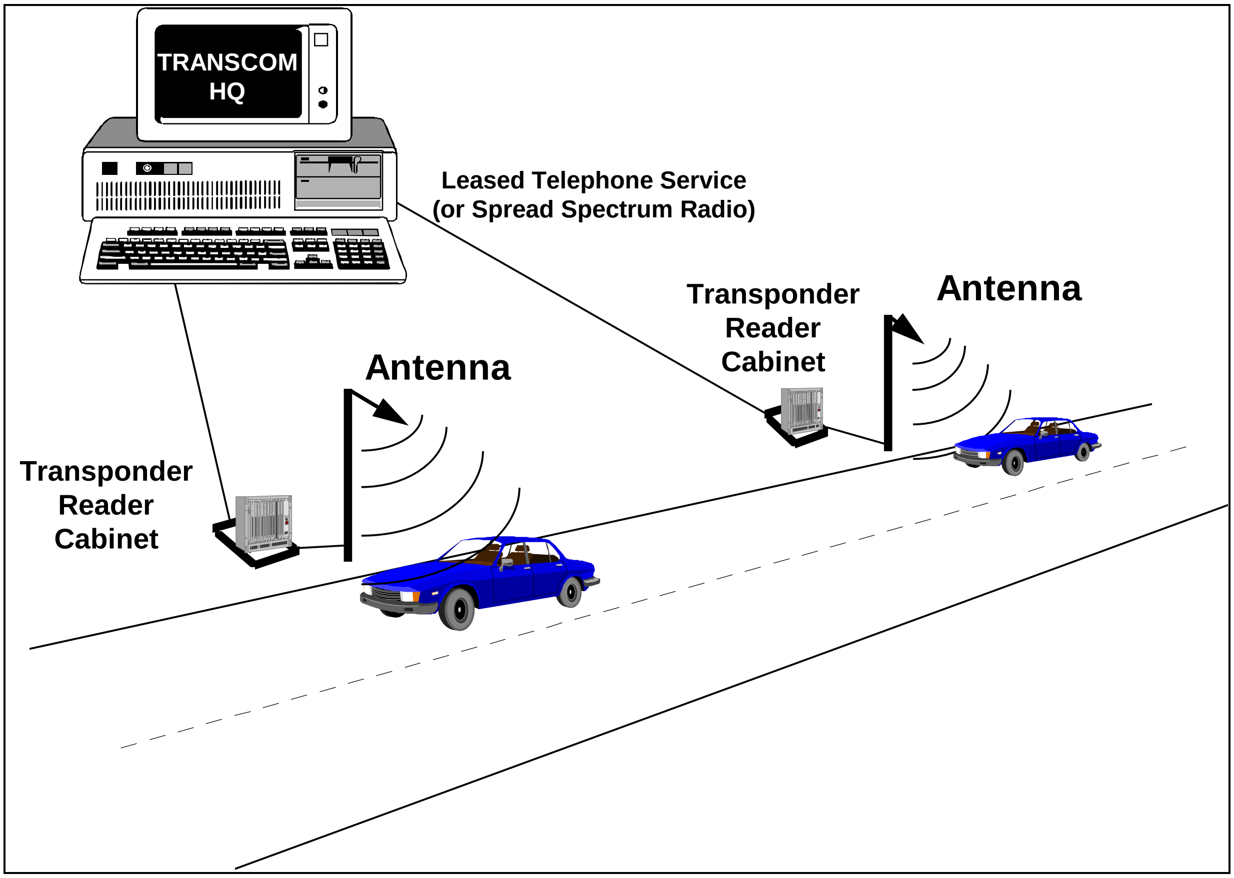


Figure 1: TRANSMIT System Schematic

At TRANSCOM headquarters, a computer processed the series of arrival times for each equipped vehicle. The computer software calculated the travel time between the readers and averaged the travel times of all vehicles passing between two readers to establish an average traffic speed for that section of highway. The computer stored this travel time information for use in traffic flow analysis. Over time, TRANSCOM built a historical database of traffic speeds by time of day (in 15 minute intervals). This database was further classified by type of day: weekday, Saturday, Sunday, and holiday.

The computer system at TRANSCOM headquarters employed a speed-based incident detection algorithm. The algorithm compared individual vehicle travel times between pairs of transponder readers to the historical database times for the corresponding type and time of day. If the transit time was greater than the historical average, the algorithm calculated the probability that an incident had occurred and the probability that there was a false alarm. As part of the development process, test personnel tuned the algorithm to reduce the number of false alarms and provide reliable incident detection capabilities.

Results

Engineers and operators at the TRANSCOM partner highway agencies (NYSTA and NJHA) have successfully applied TRANSMIT as a tool to improve their respective traffic management operations. TRANSMIT provides a significant amount of information that is useful to alert motorists and initiate traffic management actions. The information and actions include:

- **Incident detection** -- The detection algorithm successfully identifies incidents along the instrumented sections of the highways. This automatic detection capability supplements manual methods of incident detection. This capability has helped achieve the project goal of increasing safety and mobility.
- **Speeds by time and type of day** -- Engineers and operators use this information to document the varying levels of congestion on the network. The information helps them identify bottleneck locations and develop solutions to address the problems.
- **Determine staffing levels** -- Speed and volume information has helped operators establish toll booth staffing levels by type and time of day.

The historical information in the database has also helped operators respond to citizen complaints and legislative inquiries and to better understand how the road network and the traffic management systems operate.

The evaluation showed that the use of ETC transponders to provide traffic management data is feasible. TRANSMIT is able to determine link travel times and estimate mean link travel speeds.

The incident detection system performed very well during the test. The system had a 92 percent to 95 percent detection rate during the four months of this portion of the test on the NYST. On the GSP (which had a much lower volume of transponder equipped vehicles), the detection rate averaged 75 percent. Analysis conducted on the data showed a probability of false alarms (as a percentage of the total number of actual incidents) that averaged between 10 percent and 22 percent on the NYST and between 5 percent and 16 percent on the GSP. These false alarm percentages are considered to be better than any presently available from point-based surveillance system incident detection algorithms.

The communication system performed very well. Evaluators assessed the transmission and detection rates to analyze the communication system. The transmission rate for almost all locations was nearly perfect, varying from 98.8 percent to 100 percent. The detection rates varied at each transponder reader but all were able to detect more than 74 percent of the total number of transponder equipped vehicles and many readers approached a 100 percent detection rate.

The cost, benefits, and institutional issues evaluation is nearing completion and should be available for publication in December 1997.

Legacy

Traffic managers use the system for day-to-day incident detection and traffic management operations. The incident detection capabilities of the system are very good. The rates for incident detection and false alarms are among the best in current incident management systems. The system is also providing managers with traffic speed information. TRANSCOM has obtained support for a second phase of the project in which it will expand the use of TRANSMIT to a total of 150 miles of roadways. The expansion will include highways east of the Tappan Zee Bridge and highways approaching, crossing, and leaving Staten Island.

Test Partners

Edwards & Kelsey

Federal Highway Administration

Garden State Parkway

Mark IV

New Jersey Highway Authority

New York State Thruway Authority

PB Farradyne

TRANSCOM

References

ITS Online, “Inside the Self-Described ‘United Nations of Transportation,’ A discussion with the Senior Management of TRANSCOM”

Marshall, K. and Batz, T., TRANSMIT: An Advanced Traffic Management System (Draft), March 1996

Niver, E. and Mouskos, K., TRANSMIT Evaluation of Cost, Benefits and Institutional Issues, July 1997

Niver, E. et. al., TRANSMIT Evaluation of the Communication System, July 1997

Mouskos, K. et. al., TRANSMIT Evaluation of Traffic Parameters Estimation, July 1997

Mouskos, K. et. al., TRANSMIT Evaluation of the Incident Detection System, July 1997

ITS Field Operational Test Summary
TransGuide

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

Transportation Guidance System (TransGuide), Phase 1, was a non-ITS funded deployment of an Advanced Traffic Management System (ATMS) in San Antonio, Texas. It was the first phase of a planned 191-mile regional ATMS for the greater San Antonio area. It installed ATMS functions on a 26-mile freeway system circumscribing the San Antonio central business district from 1993 to 1995. The shaded area in Figure 1 shows the location of the TransGuide Project, Phase I. The Texas Department of Transportation (TxDOT) developed and directed this project.

The TransGuide Field Operational Test (FOT) consisted of an evaluation of various design aspects of this TransGuide deployment. It resulted in a published document entitled "TransGuide ITS Design Report" that provides design guidance on the TransGuide system and its major components.

Project Description

TransGuide deployment, Phase 1, developed and demonstrated advanced traffic management technology on a 26-mile portion of the San Antonio freeway system. This technology included automated incident detection, verification, and response to freeway incidents including control and management of approaching traffic upstream of the incident locations. The system used sophisticated, modern technology to provide complete control of all system functions from a single traffic management center. The TransGuide project installed a dedicated fiber optic communications network to link the field components of the system to the TransGuide Operations Center (TOC). Figure 2 shows many of the important components of the TransGuide system.

The objectives of the TransGuide deployment were to:

- Help identify traffic incidents
- Provide video surveillance of the freeway system
- Support traffic management decisions based on incident characteristics
- Allow control of lane occupancy and freeway access
- Help coordinate the dispatch of emergency response units
- Support the dissemination of traffic information to the public, private industry, and the news media.

TransGuide system deployed an innovative, high-speed digital and fiber optic communications system for voice, data, and video signals. It developed traffic management software on a fault tolerant computer system that was designed to exchange information with roadside equipment including changeable message signs, lane control signals, loop detectors, and CCTV surveillance cameras.

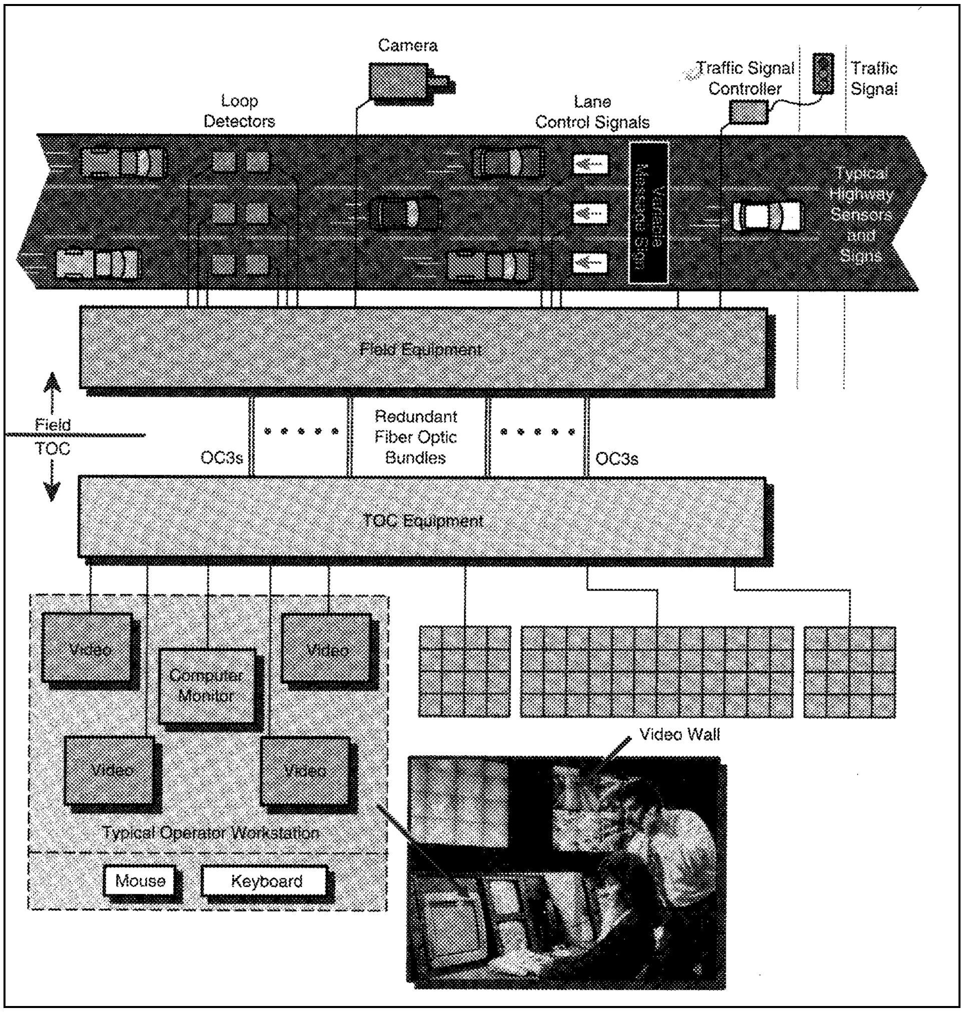


Figure 1: Important TransGuide Components—Field and TOC

TransGuide installed a network of loop detectors in freeway lanes and entrance and exit ramps and developed software-based detection algorithms to detect abnormal traffic conditions. The system alerted human operators who used a network of high magnification video cameras to verify these abnormal conditions. The TransGuide ATMS software recommended the most appropriate response plan to an incident based on a library of over 34,000 response plans (solution scenarios). Operators initiated a response plan for a specified location from the response plan library or tailored the recommended response plan if conditions required. The selected response plan activated all appropriate flow control devices including lane control signals and programmable variable message signs.

Results

The TransGuide FOT evaluated the first phase of the TransGuide deployment. The principal objectives of the evaluation were to:

- Document the architecture and system design rationale and goals

- Assess the system's success in meeting the stated incident detection goal of 2 minutes and response goal of less than 1 minute after detection
- Assess the digital communications network for cost effectiveness and benefits with respect to traditional communications systems
- Assess a representative sample of incident detection algorithms.

The evaluation resulted in a document entitled "TransGuide ITS Design Report" that conveys important information about the TransGuide Intelligent Transportation System design process. It describes design concepts and philosophies employed to meet TransGuide's goals with an emphasis on priorities and approaches. The document details important features of the completed system design and explains design and selection criteria that influenced the ultimate design choices. It defines the issues that were considered important in the design of TransGuide and illustrates how the important design decisions were made.

Some specific examples of design outputs include:

- Functional and operational requirements for the TransGuide System
- Specifications that were the defining documents in the procurement contract for fabrication, test, and delivery of TransGuide
- Detailed description of pre-engineered system responses to detected incidents (solution scenarios) and the procedures and rationale used by the system designers in developing the solution scenario library
- Detailed description of the TransGuide design that allows a basic understanding of the structure and operation of the integrated system, the system architecture, and each major system component
- Detailed description of options considered in choosing the final architecture and components and the rationale leading to design decisions
- Graphical decision tables that present the information in a condensed and easy to understand format including decision matrices used in the development of the specifications for each major system component.

The TransGuide ITS Design Report can be used as a guide in other ATMS implementation projects. The detailed design process and decision matrices enabled TransGuide planners to address the complex hardware, software, communications, and human interface issues in a systematic manner. The basic components and subsystems can be replicated in other applications and the decision matrices can be adapted to support development of similar systems.

Legacy

TxDOT continues to expand the coverage of the San Antonio freeway system using the components evaluated in the field operational test. The first phase of the TransGuide deployment led to San Antonio's selection as one of four sites for Metropolitan Model Deployment Initiative (MMDI). The MMDI introduces technologies for Advanced Traveler Information Systems. The lessons learned from this deployment are being disseminated to the ITS community through conferences and papers prepared and presented by TxDOT personnel.

Test Partners

Federal Highway Administration

Texas Department of Transportation

References

Southwest Research Institute, TransGuide ITS Design Report, June 1995.

ITS Field Operational Test Summary
Tranzit *XPress*

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Tranzit *XPress* ITS Field Operational Test evaluated a method of enhancing the response to hazardous materials incidents. Tranzit *XPress* is a system of computer hardware and software designed for use by public agencies and private transport firms involved in Hazardous Materials (HazMat) transportation. The project employed advanced monitoring and identification technologies and computerized emergency response information to facilitate and improve the response to hazardous materials incidents by emergency units.

The main objectives of Tranzit *XPress* were to:

- Demonstrate the ability to quickly identify the specific contents of a commercial motor vehicle involved in an incident while transporting hazardous materials
- Demonstrate the ability to link systems that identify, store, and allow retrieval of data for emergency response to HazMat incidents
- Evaluate the system's effectiveness at meeting the test objectives.

The Test took place from April 1996 to January 1997 in northeastern Pennsylvania (Scranton area).

Project Description

In this Test, the Tranzit *XPress* system provided a user-friendly, computerized information system to collect and make available accurate and timely information about HazMat shipments. This information would enable participating carriers and emergency responders to act more effectively and efficiently in case of an incident.

The test was limited in scope to the development and demonstration of a prototype system. The test mounted the system components in several trucks to use in perfecting the system. The test also presented "desktop" demonstrations of system operations at a motor carrier safety conference and a meeting of emergency response personnel. Test personnel then analyzed the responses of the demonstration participants.

The system had three separate components: the Information Dispatching/Operations Center, the On-Vehicle Electronics System, and Off-Vehicle Devices. Figure 1 presents a schematic of the Tranzit *XPress* system components.

The Information Dispatching/Operations Center collected HazMat information from the shipper and transmitted the information appropriately in the system. One of the Center's computer applications communicated with the transporting vehicle via cellular modem to transfer shipping orders and to maintain status information. Another application allowed the operator to maintain and update shipping information. A map visualization product displayed the location of vehicles.

A relational database stored customer, bill of lading, and material data.

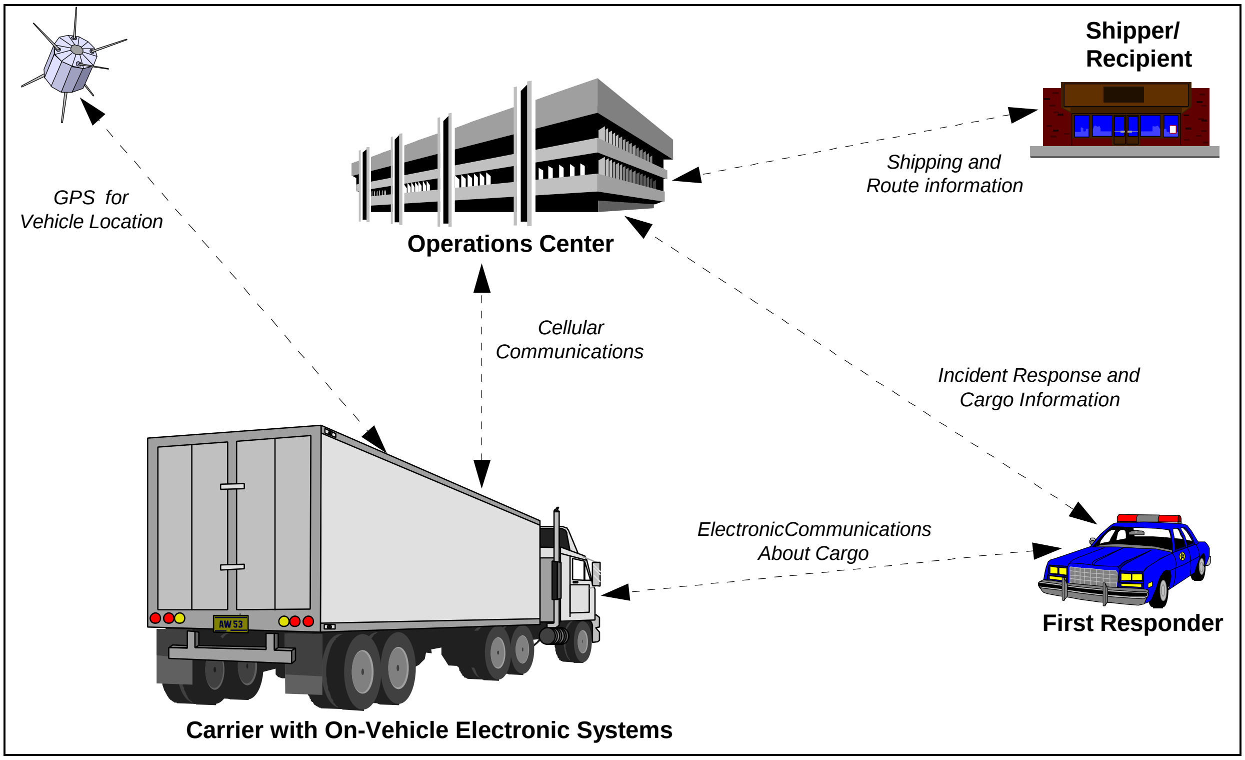


Figure 1: Schematic of Tranzit XPress System

The On-Vehicle Electronics system had two subsystems, one in the cab (tractor) and the other in the cargo box (trailer). The tractor electronics included a hand-held personal computer for the driver's use and a Global Positioning System (GPS). Tractor electronics also included an external communications systems (cellular), an internal communications system (within the cargo box), and the necessary connections between all components. The trailer electronics consisted of wireless communications devices and electronic asset tags attached to the material in transit.

In case of an incident, the Tranzit XPress system allows the driver or emergency response personnel to report the situation and obtain information about the cargo. In a non-emergency situation (for example, a leak is discovered while in transit), the driver could notify the shipping company or 911 and emergency personnel could respond appropriately to assess the situation. The emergency response personnel could electronically obtain information about the cargo to help determine the appropriate response. If the vehicle was involved in an accident, emergency dispatchers could begin notifying appropriate emergency response personnel based on knowledge of the cargo. When emergency personnel arrived at the scene, they could use electronic communications to directly obtain information about the cargo from the electronic systems on the vehicle.

Test evaluators attempted to assess three areas: system impacts and performance, user acceptance, and system deployability. The evaluators used several means to collect information on which to base their conclusions, including historical data research, surveys, and interviews of test participants.

Results

Evaluators compared the perceptions of both “Incident Responders” and Motor Carriers regarding the time required for important actions in the response to a HazMat incident. Both classes of participants perceived that the use of the Tranzit *XPress* system would result in taking less time to mitigate a HazMat incident than under the current system.

Evaluators also accumulated general perceptions from both user groups about the Tranzit *XPress* system. Incident Responders considered the system better than the existing system. These responders indicated they would use the Tranzit *XPress* system if it were implemented. Motor carrier users also perceived the system as being better than the current system. At this time, however, the system was not sufficiently beneficial or robust to cause them to begin using it.

The evaluators cautioned that the application of the observed results is limited. Some limitations stem from the focus of the test, which was to present a demonstration of the system. The results are also restricted by the small sample size of participants from the motor carrier and emergency responder communities. The process of selecting participants resulted in a sample that was not necessarily representative of the general population. Based on the project’s focus on HazMat, however, the participants selected were appropriate.

Legacy

Test participants transferred the concepts, hardware, and software developed during the Tranzit *XPress* Phase I Test to a different location after completion of the test in Pennsylvania. In this new location (Long Beach, California) test partners are further developing and testing the components as part of the Tranzit *XPress* II Field Operational Test. This second test continues to use the NIER operations center in Mayfield, PA. Phase II, however, focuses on the international movement of HazMat in and around a port facility.

Test Partners

Federal Highway Administration

Pennsylvania Department Of Transportation

NIER (National Institute for Environmental Renewal)

PAR Government Systems Corporation

References

Goulias, K. and Alam, S., Tranzit *XPress*: Hazardous Materials Fleet Management and Monitoring System, Evaluation Report, July 1997

ITS Field Operational Test Summary

Tranzit *XPress* II

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Tranzit *XPress* II ITS Field Operational Test (FOT) uses ITS technology to enhance response to hazardous materials incidents. The Tranzit *XPress* technology was developed and demonstrated in Pennsylvania as part of Phase I of the Tranzit *XPress* project. This test, Phase II of the project, expands the use of the technology to the Port of Los Angeles, in California. The project demonstrates to emergency responders several advanced communication and information handling technologies to improve emergency response information and capabilities.

Project Description

This test combines and refines the emergency response capabilities developed in Tranzit *XPress* I and Operation Respond. The FOT applies the refinements to the system developed in Tranzit *XPress* (I) to intermodal freight at the Port of Los Angeles, California. During the second phase of the project, the Tranzit *XPress* I technology will demonstrate improved HazMat visibility and more efficient HazMat incident response in Port intermodal operations. The test also will develop an open system design in accordance with ITS National Architecture for HazMat incident response. This open design will enable future integration with other ITS technologies, systems, and services. In addition, the project implements external system interfaces with electronic data interface standards to achieve compatibility with the Commercial Vehicle Information Systems and Networks (CVISN).

The system intends to provide a user-friendly, computerized information system to collect and make available accurate and timely information about HazMat movements in the Port area. The system aims to seamlessly monitor HazMat assets while in-transit across transportation modes within the intermodal Port. It is capable of locating HazMat (and other types of) cargo or containers received, transported, and stored in the facility. It will provide descriptions and locations of HazMat shipments to relevant agencies to promote safer, more efficient, and less expensive HazMat incident response.

The system has three separate components: the National Institute for Environmental Renewal (NIER) Information Dispatching/Operations Center, the On-Vehicle Electronics system, and a battery of Off-Vehicle devices. Figure 1 presents a schematic of the Tranzit *XPress* system. The on-vehicle electronics allow personnel to record and maintain cargo information and status and to communicate destination information. The Center manages communications between the shipper, the vehicle, and the emergency response vehicles and manages information collection and distribution. The off-vehicle devices (palm top or laptop computers) help identify and monitor the contents and status of the cargo. In the event of an incident, emergency response units can use the off-vehicle devices or query the NIER Operations Center to obtain timely and important information about the cargo.

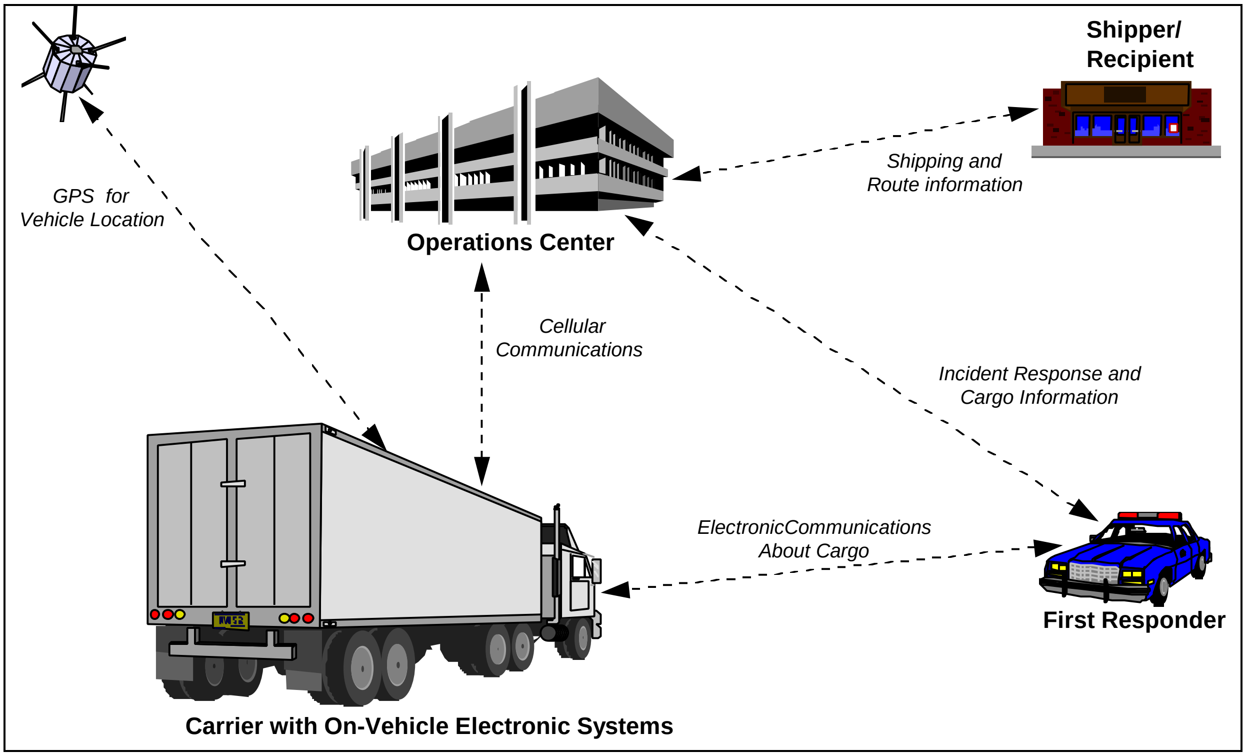


Figure 1: Schematic of Tranzit XPress System

The test evaluator will assess the project in light of its evaluation goals. The evaluation will focus on the following:

- Determine the timeliness of the initiation of the correct hazardous incident response
- Assess the performance of the system components
- Assess system suitability and user acceptance
- Identify system requirements and assess the potential for deployment
- Identify the institutional and legal issues.

Test Status

The National Institute for Environmental Renewal, the lead partner, has assigned a new project manager. The contract with NIER was modified in February 1998. This modification extensively revised the agreement to incorporate the next phase of funding, Tranzit *XPress* IIb, which involves the demonstration of the Tranzit *XPress* system at the Port of Philadelphia, Pennsylvania and at selected emergency response dispatch centers.

The evaluator has performed exploratory interviews with first responders in the Port of Los Angeles area and included this information gained in a draft Evaluation Plan.

Test Partners

Federal Highway Administration

National Institute for Environmental Renewal

Operation Respond Institute, Inc.

PAR Government Systems Corp.

Port of Los Angeles

References

None published

ITS Operational Test Summary
Travel Aid

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Travel Aid ITS Field Operational Test intends to improve safety and reduce accidents for travelers crossing the Snoqualmie Pass along Interstate 90 north of Seattle, Washington. The test will achieve this goal by transmitting suggested speed limits and traveler advisory messages to variable message signs (VMS). The Travel Aid system broadcasts advisories throughout the 40-mile length of freeway included in the Travel Aid test.

Field testing is currently underway. A final evaluation report is expected in September 1998.

Project Description

Accident data has shown that the accident rate on I-90 across Snoqualmie Pass in January is 12 accidents per 100,000 vehicles; during July the rate is 1 accident per 100,000 vehicles. During winter, snow, ice, fog and other weather extremes make driving more difficult than at other times. The traffic mix over the Pass in winter months includes recreational travelers traveling to and from the various wintertime recreation destinations, as well as a significant number of tractor-trailers. The trucks must proceed at reduced speeds when climbing or descending the Pass. During inclement weather, snow removal equipment is out in force to maintain the roadway. The Washington State Patrol and Washington State Department of Transportation maintenance staff have indicated that many accidents are caused by drivers traveling too fast for the prevailing weather and traffic conditions. The result is a very high winter season accident rate.

The goal of the Travel Aid test is to reduce the frequency and severity of accidents on Snoqualmie Pass. The test focuses on the winter weather season, but is applicable to any time of year, since weather and driving conditions are unpredictable and can be severe due simply to the elevation of the Pass.

Travel Aid transmits speed limit information and traveler advisory messages to variable message signs (VMS) [State police have issued citations to motorists exceeding the speed limit posted on the VMS.] The Travel Aid system provides three types of information to a software-based algorithm that generates suggested speed limits for vehicles. Radar detectors gather average vehicle speed data. Sensors embedded in the pavement determine pavement conditions. Weather stations record information including wind speed, temperature and precipitation. Figure 1 presents the design overview of the system.

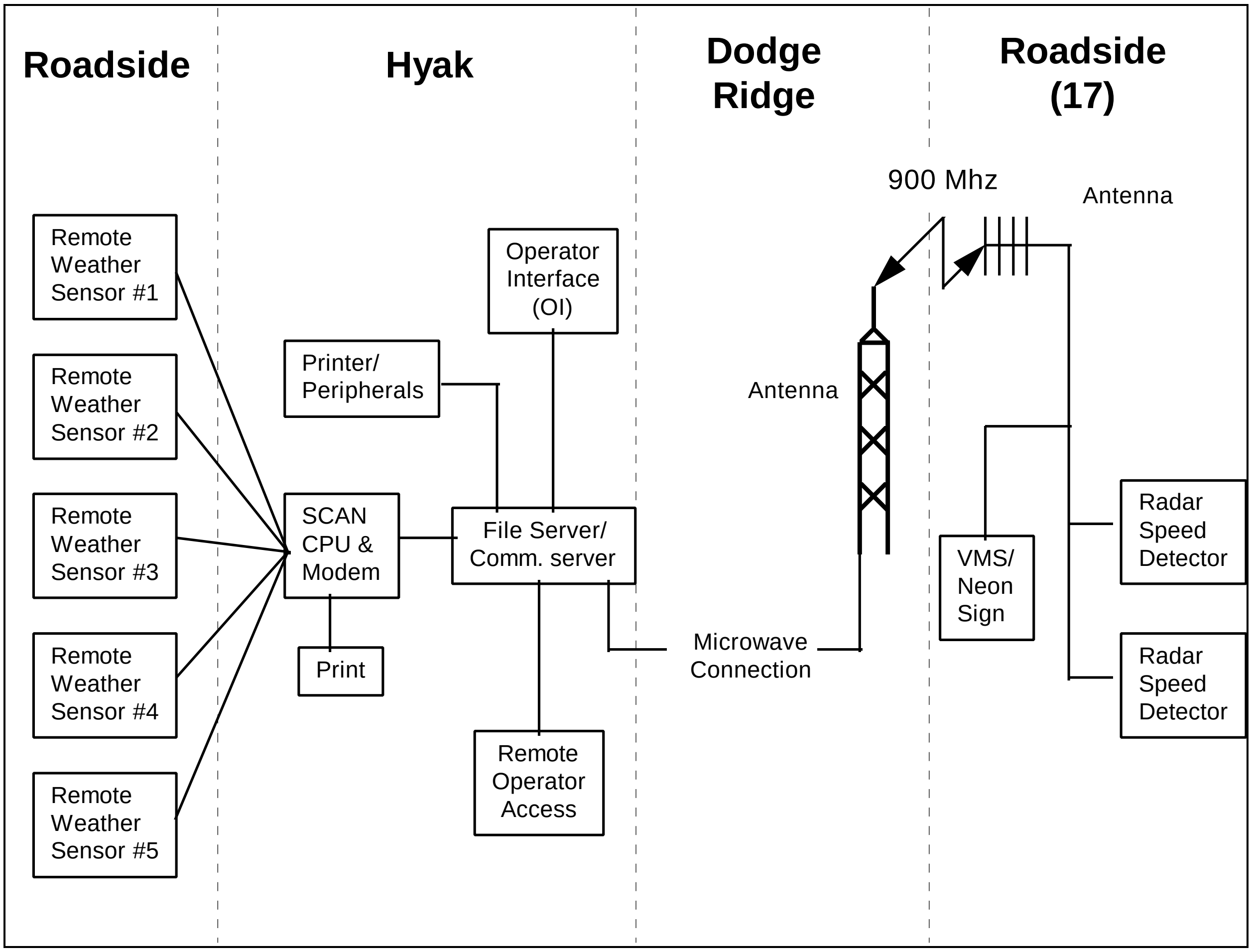


Figure 1: Travel Aid System Design Overview

This information is synthesized and processed in the central Travel Aid file and communications server at the operations center in Hyak. The computer algorithm suggests a speed limit and the Travel Aid operator reviews it. If the operator concurs with the limit, he transmits traveler advisory messages to the variable message signs (VMSs) and in-vehicle units. This transmission occurs via radio and microwave.

Test Status

The test is underway and test personnel are collecting evaluation data. No interim results are available.

Test Partners

Federal Highway Administration

General Logistics

PB Farradyne

University of Washington

Washington State Department of Transportation

References

Senn, Larry L. and Bjorge, Eilert; ITS Field Operational Test Contracting: Avoiding Surprises

ITS Field Operational Test Summary

Travel Demand Management/Emissions Detection (TDM/ED)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Travel Demand Management/Emissions Detection ITS Field Operational Test, conducted in Ada County (Boise), Idaho, evaluated two ITS technologies: license plate recognition (LPR) and remote sensing devices (RSDs). The test employed these two technologies in three applications that made up the three phases of the test:

- Phase I: Conduct Origin/Destination (O/D) studies
- Phase II: Monitor emission levels of vehicles in the field and compare the emission levels of regularly tested autos (registered in Ada County) to those not tested
- Phase III: Measure emission levels of vehicles in the field to determine the feasibility of supplementing or replacing the Ada County idle emissions testing program.

Data collection for Phases I and II took place in April 1995 and for Phase III in May 1995. Analysis of the data continued until January 1996.

Project Description

The test goal was to evaluate the practicality, effectiveness, and cost of using new technologies to conduct Origin/Destination studies and to monitor vehicle emissions in the field. Test personnel used the infrared RSD to analyze the carbon monoxide (CO) content of a vehicle's exhaust and used the LPR to obtain information to associate the emissions reading of the vehicle to its owner. Figure 1 shows the system components and configuration.

Phase I of the test determined whether the two technologies could be used to conduct Origin/Destination studies in a simpler and less costly manner. Test personnel used the information collected to prepare and immediately mail O/D surveys to all identified vehicle owners. Test personnel then evaluated the number and quality of the returned surveys.

The aim of Phase II was to determine the relative contribution to CO pollution produced by vehicles registered outside Ada County (and not regularly tested for emissions) compared to the contribution of regularly tested vehicles from the county. Test personnel identified those out-of-county vehicles emitting an unacceptably high level of emissions. The test then evaluated the effectiveness of different incentives to promote voluntary adjustment of high emitting vehicles.

Phase III determined whether RSD technology could provide reliable CO emissions data. Test personnel evaluated whether the technology could enhance the existing idle emissions testing program while reducing program costs. Test personnel compared the results of the idle emissions tests of vehicles registered in ADA County to the emissions readings taken by RSD to assess the accuracy of the RSD measurements. They evaluated whether RSD testing could replace or supplement the idle emissions testing program.

In each phase, test personnel evaluated the performance of the two technologies, the impacts of the use of each technology on the transportation system, and the benefits to air quality. In addition, they evaluated the institutional and legal issues, users' acceptance of such a system, and the costs.

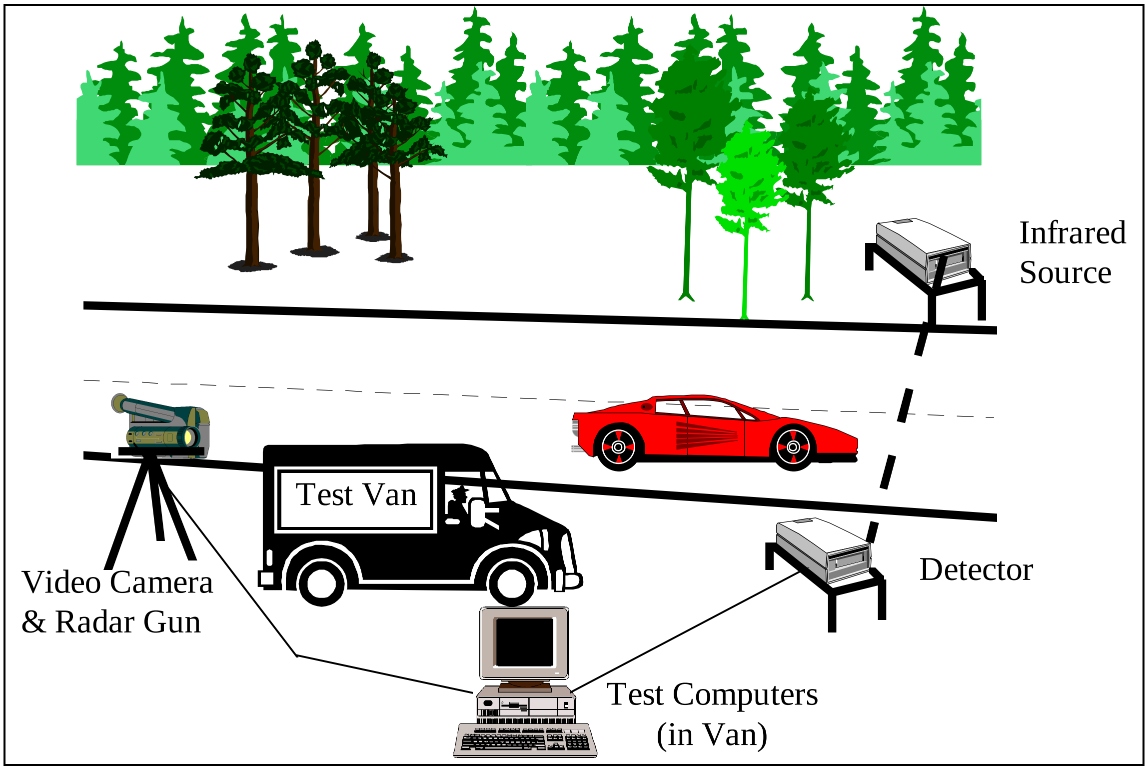


Figure 1: System Components and Configuration

Results

Overall, the RSD system performed well and transportation impacts were minimal.

The results of Phase I, Origin and Destination Surveys, demonstrated that LPR technology facilitated conducting an O/D survey in which motorists did not have to stop. The resulting automation of the travel survey process led to quick survey turnaround and high quality responses. The test methodology minimized hazardous driving incidents, eliminated disruption of traffic flow, and reduced the inconvenience to the motorists. Although the cost effectiveness of LPR technology was not conclusive, the hidden costs to the motorists and the field technicians (for example, convenience and safety) would justify its use for future O/D surveys. The test achieved a 37 percent return rate on the mailed surveys. Although the cost per returned survey using the LPR method ($8.86) was greater than in other similar tests, the cost per survey site ($5,120) was less than similar costs for other survey methods.

The test results of Phase II, Emissions Monitoring at Field Stations, showed that RSD technology can quickly and accurately measure a moving vehicle's emissions. The information collected during the test demonstrated that Ada County registered vehicles (tested annually) had a significantly lower average emissions level (10 percent to 15 percent) than non-tested vehicles. RSD technology provided a valuable opportunity to enhance existing air quality programs. RSD technology was capable of capturing license plate and emissions data to determine whether non-tested vehicles produced more emissions than tested vehicles. This information will support the consideration of enhancements to existing air quality programs.

A careful analysis of the test results from Phase III, Emissions Monitoring of All Vehicles in Ada County, showed that the data collected was insufficient to support a definite conclusion on the use of the technology as a replacement to the idle emissions testing. The test results did not support a strong relationship between a single RSD measurement and an idle emissions test reading. Although no strong relationship exisited between these data, the RSD technology accurately observed and recorded data. Over 85 percent of the license plates were readable by LPR equipment with minimal staff assistance. (In Phase I, this figure was 76 percent.) The emissions sensing equipment recorded over 92 percent of valid carbon monoxide (CO) readings and 80 percent of valid CO and acceleration readings.

There is evidence, however, that RSD screening of a vehicle fleet, using an average of multiple readings, could provide for the identification of vehicles having a high probability of passing an idle emissions test. This group may constitute 90 percent or more of all vehicles in Ada County. Test personnel felt that cutpoints to identify “clean” vehicles and exclude them from testing with an acceptable level of confidence could be developed.

Test personnel cited several potential uses for the technology. The capability of LPR equipment to identify “out-of-area” vehicles (not subject to emissions testing) would make it possible to include them in an emissions testing program. The ability to identify “high emitting” vehicles would allow earlier detection and emissions testing of those vehicles. The exemption of “clean” vehicles from an emissions testing program would eliminate the inconvenience and cost to a significant number of vehicle owners.

In addition, the test results for all phases showed a favorable rating from the public to the use of LPR/RSD technology. The majority of telephone survey participants and policy makers did not consider it to be an invasion of privacy to take a video of the license plate, identify a vehicle owner’s name and address in the motor vehicle records, and mail the owner a travel survey. A majority also did not consider RSD technology to be an invasion of privacy. Over 86 percent of telephone survey participants preferred the LPR method of conducting O/D surveys to the stop-and-ask method. Approximately 72 percent of the telephone survey participants preferred to have their vehicle’s emissions tested using the RSD method rather than the idle emissions test station method.

Legacy

All system components are currently available commercial products. The project discontinued operation after completion of the test. Future application plans for this type of technology are unknown.

Test Partners

Idaho Department of Transportation

Ada Planning Association

Ada Air Quality Board

Federal Highway Administration

References

Ada Planning Association, Individual Evaluation Test Plan Report #1, Origin and Destination Survey and Emissions Monitoring at External Stations, Final Report, April 1996

Ada Planning Association, Individual Evaluation Test Plan Report #2, Emissions Monitoring of All Vehicles in Ada County, Final Report, April 1996

ITS Field Operational Test Summary
Travel Technology

FHWA Contact: Office of Travel Management and ITS Applications, (202) 366-0372

Introduction

The TravTek ITS Field Operational Test contained a series of field tests, experiments, and analytical studies focused on Advanced Traveler Information Systems (ATIS) and Advanced Traffic Management System (ATMS) concepts. The test was conducted in Orlando, Florida, from November 1991 to June 1994.

Project Description

TravTek consisted of three main components:

- The TravTek In-Vehicle System was installed in 100 specially-equipped vehicles
- The information was collected and processed at the Orlando Traffic Management Center (TMC)
- Customer information and services were provided by the TravTek Information and Services Center (TISC).

The TravTek In-vehicle System for each vehicle had a two-way communication link with the TMC and the TISC via a hands-free cellular phone. The vehicles received a broadcast of traffic information from the TMC and broadcast once per minute to the TMC their locations and travel times across TravTek traffic links they had recently traversed. Figure 1 presents the system configuration and relationships.

The vehicles could be configured three ways:

- Services: provided drivers with local information (yellow pages)
- Navigation: added route planning and guidance capabilities
- Navigation Plus: included all services and navigation features, plus display of real-time traffic information and route planning around congestion.

The TMC received traffic information from several sources, processed this data, and transmitted current traffic conditions to the TravTek vehicles. Data sources included the Florida Department of Transportation Freeway Management Center, Orlando's traffic control system, a network of public and private sector reporting stations, and TravTek vehicles. Information included link travel times, incident status, and the location of congestion. Link travel times were broadcast one time every minute for any of the 1,488 traffic links for which travel times were greater than normal.

The TISC provided help-desk services to TravTek users. It also provided and maintained the navigational map database used in the vehicles. This database represented a 3,100 km^2 area of metropolitan Orlando and consisted of approximately 74,000 navigational road links. The database was updated and corrected throughout the test. The TISC also managed the local information directory database and the reservation database.

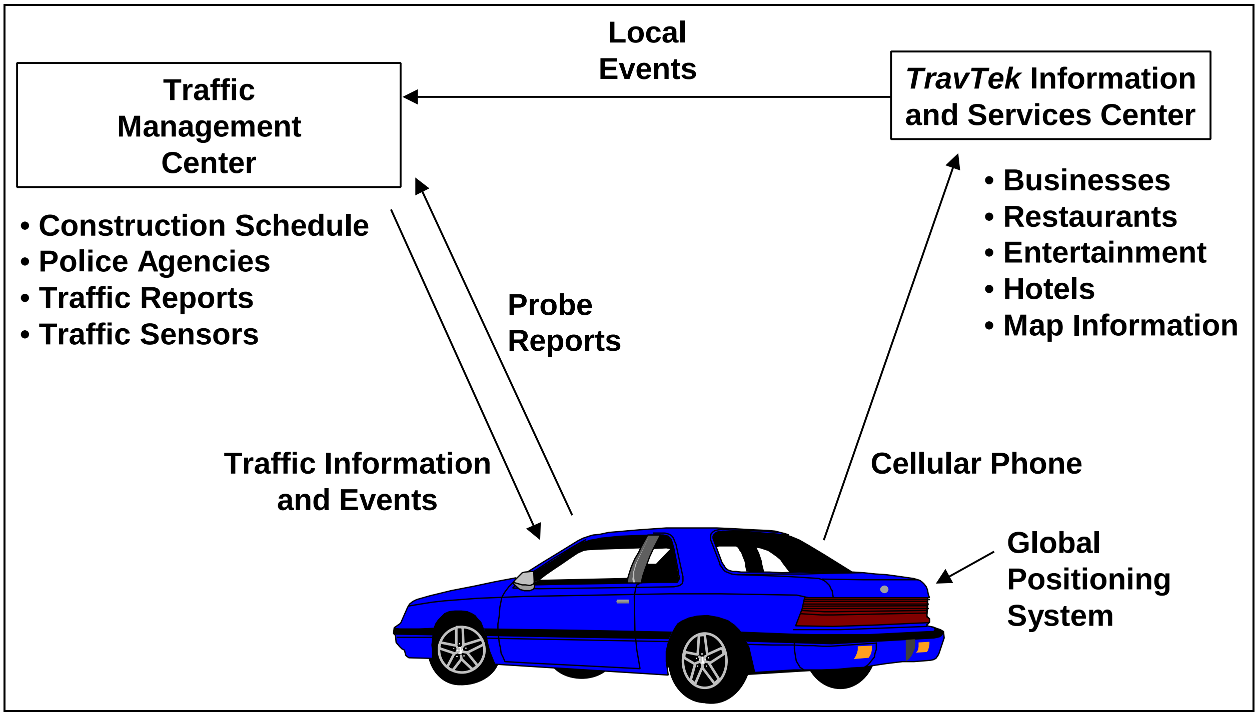


Figure 1: TravTek System Configuration and Relationships

The TravTek Network consists of two types of database links in the coverage area. These links were defined as follows:

- TravTek Links: defined in the navigable database maintained by the TISC (approximately 74,000 links over 16,000 km of roadway)
- Traffic Network Links: represented sections of roadways for which real-time traffic information could be transmitted (1,488 links over 1,854 km).

The TravTek Evaluation was focused around the following questions:

- Will the TravTek system work?
- Did drivers save time and avoid congestion?
- Will drivers use the system?
- How effective were the visual turn-by-turn, moving map, and voice guidance displays?
- Was TravTek safe?
- Could TravTek benefit travelers who do not have the TravTek system?
- Will people be willing to pay for TravTek features?

The field studies consisted of the Rental User Study and the Local User Study. The Field Experiments included the Yoked Driver Study, the Orlando Test Network Study, and the Camera

Car Study. The analytical studies included the Modeling Study (integration), the Safety Study, and the TravTek Architecture Evaluation Study.

Results

The results are presented according to the several main evaluation questions.

Did the system work?

The TravTek system was very reliable. System up-time exceeded 96 percent. Vehicle-to-TMC and TMC-to-vehicle communications were reliable enough to meet system requirements.

The probe vehicle concept worked very well. The TravTek vehicles distributed themselves across the network such that with a greater number of vehicles deployed, excellent network coverage could be achieved for obtaining probe vehicle travel times.

The distributed architecture performed well. System reliability and the perception of reliability resulted, in great measure, from the ability of the vehicles to perform their own route planning. Centralized route planning would have placed more demands on TMC infrastructure while increasing the vulnerability of the system to single-point failures.

The overall accuracy of the TravTek databases was high. The fuzzy logic algorithm for fusing traffic data at the TMC worked well.

The system provided a very high level automation: travel-time data was collected, processed, and distributed to the vehicles without the need for operator intervention. Incident data required intervention and changes in operator training and interfaces were recommended.

A need for better incident reporting was identified. The system did not have enough active incident data sources. A need for procedural changes to increase incident reporting timelines was also identified.

Drivers found the system easy to learn, easy to use, and useful. Aside from the reliability of the traffic information, users perceived the system to work well.

Did drivers save time and avoid congestion?

TravTek was found to save trip-planning time and to reduce travel time. Real-time traffic information did not further reduce TravTek users' travel times, but the modeling results indicate that when using real-time traffic information, TravTek reduced network congestion and therefore reduced overall network travel times.

In all three field experiments the results were uniformly positive: for trips to unfamiliar destinations, both visitors and local users saved considerable time in planning trips when they used the TravTek system.

The TravTek route guidance system was found to reduce travel time in all three field experiments, regardless of the TravTek display configuration used to communicate routes to the drivers. The TravTek Navigation Plus configuration was shown, in the Yoked Driver Study, to successfully avoid congestion. Although the TravTek system helped vehicles avoid congestion, there was no observed travel time savings associated with congestion avoidance. To avoid congestion, vehicles took slightly longer routes on lower-class roadways and, as a result, travel time remained about the same.

Will drivers use the system?

Those rental users who drove with the Navigation Plus and Navigation configurations used the TravTek system on approximately 80 percent of all their trips.

At the end of 2 months of experience with the system, local users were still using TravTek to plan routes for over 40 percent of all their trips.

Responses indicated that people will use TravTek-like systems for route planning and route guidance.

Services users used TravTek on 37 percent of their trips: an indication that there is a demand for in-vehicle databases of local services and attractions even when it is not integrated with a navigation and route guidance system.

How effective were the turn-by-turn, moving map, and voice guidance displays?

There were few differences in driving performance among the alternative display configurations. Overall, workload measures indicated that any TravTek configuration was preferable to the control configuration. Among TravTek displays, the Route Map without supplemental Voice Guide instructions yielded slightly higher workload and marginally lower performance compared to the Guidance Display (with or without Voice Guide), the Route Map with Voice Guide, or the Voice Guide alone.

Drivers generally reported that the TravTek route guidance option helped them pay more attention to their driving and helped them find their way. Among the TravTek display combinations, the field experiments showed the Guidance Display with Voice Guide yielded the most safe driving performance.

Rental users, who were largely visitors to Orlando, used the turn-by-turn Guidance Display far more than the Route Map. Rental Users also tended to leave the Voice Guide on—over 85 percent of the time—while they were driving.

Local users also used the Guidance Display more than the Route Map, and kept the Voice Guide on more than off. Local users used the Route Map more than renters (about one-third of the time) and drove with the Voice Guide on approximately 70 percent of the time.

For route guidance, TravTek results strongly support the use of supplemental voice instructions, as they yielded better performance than visual displays alone. In designing future systems, if a decision must be made between moving map and turn-by-turn displays, the TravTek results—both performance and user performance—favor the turn-by-turn display. Only one example of each type of display was evaluated in TravTek. Therefore, this recommendation may not be applicable to all implementations of turn-by-turn or map displays.

Was TravTek safe?

The field and safety studies showed that ATIS can be employed under normal operating conditions without degrading safety. There was no evidence that TravTek was the cause of any accidents, and the number of accidents involving TravTek vehicles did not appear to be greater than would be expected based on national averages.

The TravTek Safety Study contains an extensive discussion of the problems involved in interpretation of ITS operational test accident experience. With accident probabilities measured in millions of vehicle kilometers per year, and ITS evaluations typically compiling fewer than 2 million kilometers per year, techniques other than accident and incident tabulations and accident investigations should be employed to meaningfully evaluate safety.

The TravTek Safety Study made extensive use of modeling to project safety impacts of the TravTek system for both TravTek-equipped vehicles and for non-equipped vehicles sharing a network with equipped vehicles. The results projected that, under levels of market penetration higher than 30 percent or on networks with traffic demand no higher than that observed in Orlando, there would be no increase in safety risk. In the absence of congestion, the TravTek system results in a safety benefit regardless of level of market penetration because its routing algorithm has a bias towards safer roadways. A TravTek-like system was projected to present a slight increase in risk to users under conditions of high traffic demand and low levels of ATIS market penetration. Under these conditions, TravTek vehicles divert to less safe roadways when primary routes are congested. With low market penetrations, a high percentage of TravTek vehicles would divert under high traffic demand. With higher levels of market penetration, only a small percentage of TravTek vehicles need to divert and the overall reduction in congestion results in a net safety benefit. The Modeling Study findings apply to conditions similar to those in Orlando and to systems equipped similar to the TravTek Navigation Plus configuration.

<u>Could TravTek benefit travelers who do not have the system?</u>

The Modeling Study findings suggest that traffic network users, both those equipped with the systems and those not equipped, would derive numerous benefits, largely because TravTek-equipped vehicles avoid congestion and thereby avoid increasing congestion. Thus, benefits grow directly with market penetration for most measures of effectiveness.

From the Modeling Study, as market penetration increases, non-users will experience substantial benefits in reductions to travel time, number of stops, fuel consumption, and hydrocarbon and carbon monoxide emissions. Non-users can expect an increase in nitrous oxide emissions, which are associated with higher speeds.

<u>Will people be willing to pay for TravTek features?</u>

Across all field studies and experiments, users indicated that they would be willing to pay more than $900 for a TravTek system. Fifty percent of the Navigation and Navigation Plus renters indicated that they would be willing to pay $1,000 or more. Fifty percent of the Services configuration users indicated they would be willing to pay $500 or more for a similar type of system. The median willingness-to-pay estimate from local users was slightly under $1,000. Across all field studies, median estimates of added-value of the full TravTek system in a rental car ranged from $28 to $35 per week. There appears to be a strong market for the TravTek systems if they can be priced close to or less than $1,000.

Legacy

The system ceased operations as a test immediately after data collection was complete. Some individual components of the physical infrastructure, such as the video cameras on I-4, are still being used to provide traffic management functions in the Orlando area.

The results from TravTek provided a springboard for later ITS deployments, including the Atlanta ATMS and the Model Deployments Initiative. Partners that were a part of this test have been very active in commercial enterprises to deploy vehicle navigation systems nationally.

Test Partners

American Automobile Association

City of Orlando

General Motors

Federal Highway Administration.

References

Federal Highway Administration, Turner Fairbanks Highway Research Center, TravTek Global Evaluation and Executive Summary, Publication #FHWA-RD-96-031, March 1996.

ITS Operational Test Summary

TravInfo

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The TravInfo ITS Field Operational Test evaluates a regional Advanced Traveler Information System (ATIS) in the San Francisco Bay Area. The ATIS provides up-to-the-minute traffic information and current transit and ride-share information to Bay area travelers. TravInfo provides traveler information through a regional no-area-code telephone number. It aims to:

- Collect, integrate, and broadly disseminate timely and accurate traveler information throughout the San Francisco Bay Area
- Stimulate and support the deployment of a wide variety of ATIS products and services leading to the creation of a competitive and viable market
- Test the value and effectiveness of a public/private partnership to collect and disseminate traveler information.

The test began operations in October 1996. It will continue to operate until December 1998 when the Final Evaluation Report is expected.

Project Description

As a regional ATIS, TravInfo aims to increase transportation efficiency by providing timely and accurate traveler information in the San Francisco Bay Area. The dark bands shown on some highways in Figure 1 indicate the route segments incorporated in TravInfo.

The TravInfo project collects information from several data sources, integrates it into a single, comprehensive database, and disseminates the information to the public, both directly and through third parties.

Information on speed and congestion comes from the California Department of Transportation's (CalTrans's) Traffic Operations System in Oakland. This system is an area-wide network of freeway sensors and closed-circuit television cameras. Similar information comes from the Freeway Service Patrol's roving fleet of tow trucks. These trucks contain an automatic vehicle location system. The California Highway Patrol's Computer-Aided Dispatch (CAD) system provides information on accidents and other incidents. Additionally, the CAD system provides data on construction work, other road closings, and sports events or concerts that may affect traffic.

The TravInfo database also contains transit information from the Metropolitan Transportation Commission. In addition, the TravInfo Traveler Information Center (TIC) in Oakland gathers information on bicycling and park-and-ride facilities. The TIC screens, processes, and formats the information in a uniform database before disseminating it to the public and the private sector. The TIC houses the public domain database and supports its update and dissemination.

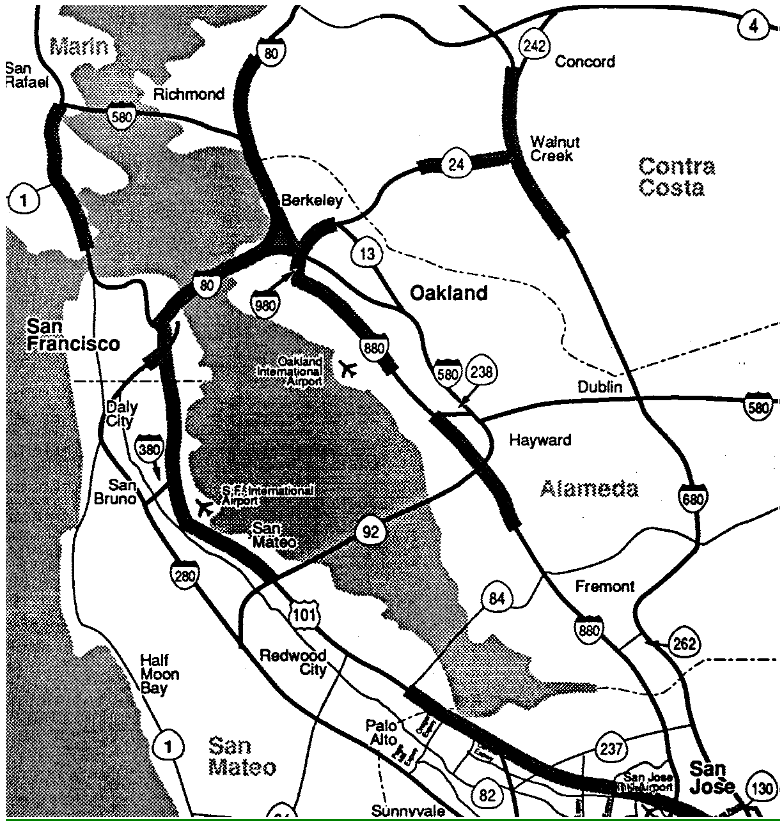


Figure 1: TravInfo Test Area

The public can access the TravInfo information by dialing the toll-free TravInfo Telephone System number. Once connected, the caller uses a menu-based, automated voice telephone system called the Traveler Advisory Telephone System (TATS). At the user's request, the TATS will switch callers to a human operator for assistance in planning a transit trip or forming a carpool. All other information is available in an automated format.

Transit features include route, schedule, fare, and multi-modal transfer node information. Additional transit features are trip planning between prominent origins and destinations (such as central business districts, event venues, schools, and shopping centers). TATS also offers information on transit station locations and park & ride parking availability. The system even offers information on bikeways.

TravInfo's traffic information consists of incidents and congestion on major roadway systems. TravInfo offers on-the-spot ridesharing, in conjunction with transit/trip planning. This service proposes to reduce single occupancy vehicle trips and general congestion.

In addition to TATS, TravInfo disseminates data in electronic form through a modem-based Landline Data Server (LDS). Value-added resellers and local public agencies can access this information. These organizations can reformat the information in ways that would be useful to potential markets and their constituencies. In addition to enhancing information already available through the broadcast media (radio and TV), these organizations can offer a variety of products using the TravInfo information, such as pager systems, cellular phones, on-line computer services, in-vehicle navigation systems, and kiosks.

The evaluation of the test assesses the effects of TravInfo on a broad array of issues including:

- Entrepreneurial response to improved travel information
- Changes in individual travel behavior
- Impact on overall transportation system performance
- Value and effectiveness of public/private partnership
- Timely and accurate dissemination of traveler information through the Bay area.

Test Status

The TravInfo test began operations in October 1996 and will continue until December 1998. The TravInfo Management Board is currently considering various issues pertaining to TravInfo's potential deployment after the test. Several interim evaluation reports have been published. These reports examine institutional issues, traveler response, value-added resellers, and the performance of the Traveler Information Center. A brief synopsis of these reports follows.

Interviews conducted with members of the Management Board, the Steering Committee, and the Advisory Committee indicated that TravInfo has been quite effective in achieving the goal of developing a partnership between the public and private sectors. The interviews showed that private sector participants felt involved in the project and believed that the public sector had listened and responded to their concerns. At the same time, interviewees believed that the organization's efficiency could be further enhanced by better defining the roles and responsibilities of the Steering Committee and the Working Group.

Implementation issues dominated TravInfo during the second year of testing. These issues included public/private controversies in the design of TravInfo and completion of a temporary data collection center to meet the TravInfo test schedule. The majority of the partners agreed that the TravInfo organization had been effective at resolving these issues. They felt that TravInfo strengthened the public/private partnership by establishing a clear and balanced vision for the public and private sectors. This vision assigned to the public sector the responsibility for data collection and database operation/supervision. The vision also promoted the private sector's development of products and services. This vision has helped delineate the explicit boundary between public and private responsibility with respect to data broadcasts and data processing issues.

Evaluators conducted interviews during fall of 1995 with registered value added resellers (VARs). The VARs indicated that TravInfo has stimulated their business opportunities. The VARs also felt TravInfo has effectively resolved the ATIS competition issue between public and private sectors. The VARs support the project and plan to disseminate TravInfo information through their products and services. VAR participation, however, depends on their satisfaction with TravInfo's data and operations. The primary goal of the VARs is to test the ATIS market. Presently, three project partners are offering real-time information to the public through the Internet:

- Maxwell Technologies, Inc. and the Contra Costa Times provide real-time traffic information.
- ETAK provides Bay Area Traffic Pages.

Surveys of travelers conducted during November 1995 indicated that three quarters of the participants listen to traffic reports, at least occasionally. Approximately one half of those who listen to traffic reports change their travel habits because of the information they hear. These travelers listed being able to make informed travel decisions, save travel time, and reduce anxiety as benefits of the TravInfo services.

Evaluators examined the performance of the Traveler Information Center (TIC). This examination found a total of 73 system reliability problems during the period from January to June 1997. Eighty-nine percent of the problems originated within TransView, the primary TIC program. The operator's role in the flow of information through the TIC has been crucial in terms of data entry, data interpretation, and prioritization. The two most time-consuming data sources are the California Highway Patrol's Computer Aided Dispatch (CAD) system and Metro Network's airborne reports.

The publicly available traveler information telephone service, TATS, recorded a constant monthly volume of between 50,000 and 60,000 calls from September 1996 to June 1997. TATS usage for Oakland, the busiest regional system, averaged only three percent of the system's capacity. The private sector access of the data, via the Landline Data System, has also been quite limited.

The results of telephone surveys conducted of 212 commuters immediately following two congestion-causing incidents suggest that traveler behavior is largely unaffected by individual incidents or congestion. Furthermore, although many commuters listen to traffic reports, they do not often respond by modifying their travel behavior. The survey showed that even if they are aware of incidents, travelers do not believe that changing their travel plans will result in shorter travel times. The survey results also indicated that most participants were unfamiliar with TravInfo. Even the 75 percent of those who were familiar with the service never used it.

Test Partners

California Department of Transportation

California Highway Patrol

Federal Highway Administration

Metropolitan Transportation Commission (MTC)

TRW

References

Hall, Yim, Pfeifle, and Weissenberger, <u>TravInfo Evaluation: Institutional Element Phase 1 Results, California Path Working Paper UCB-ITS-PWP-95-01</u>, February, 1995.

Hall, Loukakos, Weissenberger, and Yim, <u>TravInfo Evaluation: Institutional Element Phase 2 Results, California Path Working Paper UCB-ITS-PWP-96-14</u>, August, 1996.

Loukakos, Hall, Weissenberger, and Yim, <u>TravInfo Evaluation: Value Added Reseller (VAR) Study Phase 1 Results, California Path Working Paper UCB-ITS-PWP-96-13</u>, August, 1996.

ITS Field Operational Test Summary
TRAVLINK

FHWA Contact: Office of Traffic Management and ITS Applications (202) 366-0372

Introduction

TRAVLINK was a Minnesota Department of Transportation (MnDOT) Guidestar project that enhanced Advanced Public Transportation Systems (APTS) for the Twin Cities region. The project demonstrated the use of Automatic Vehicle Location (AVL), Computer-Aided Dispatch (CAD), and Automatic Vehicle Identification (AVI) systems on Metropolitan Council Transit Operations (MCTO) buses in Minneapolis and its western suburbs. The project distributed real-time bus schedule and traffic information to travelers using Advanced Traveler Information Systems (ATIS).

Project Description

Figure 1 illustrates the TRAVLINK test area. The corridor used in the test was a newly reconstructed freeway that included significant transit and ridesharing facilities. AVL transmitters were used in 80 MCTO buses. A workstation at MCTO's Transit Control Center provided two-way communication with the buses. It also sent real-time bus status information to a computer server at the MnDOT Traffic Management Center (TMC) in downtown Minneapolis. From the TMC, bus status and other travel information, such as real-time traffic conditions, were reported to several sites. These sites included three travel information kiosks located in downtown Minneapolis and two video monitors and four electronic signs located at MCTO park-and-ride lots along the I-394 corridor. The information was also sent to 212 TRAVLINK on-line users with video text terminals or personal computers at home or work.

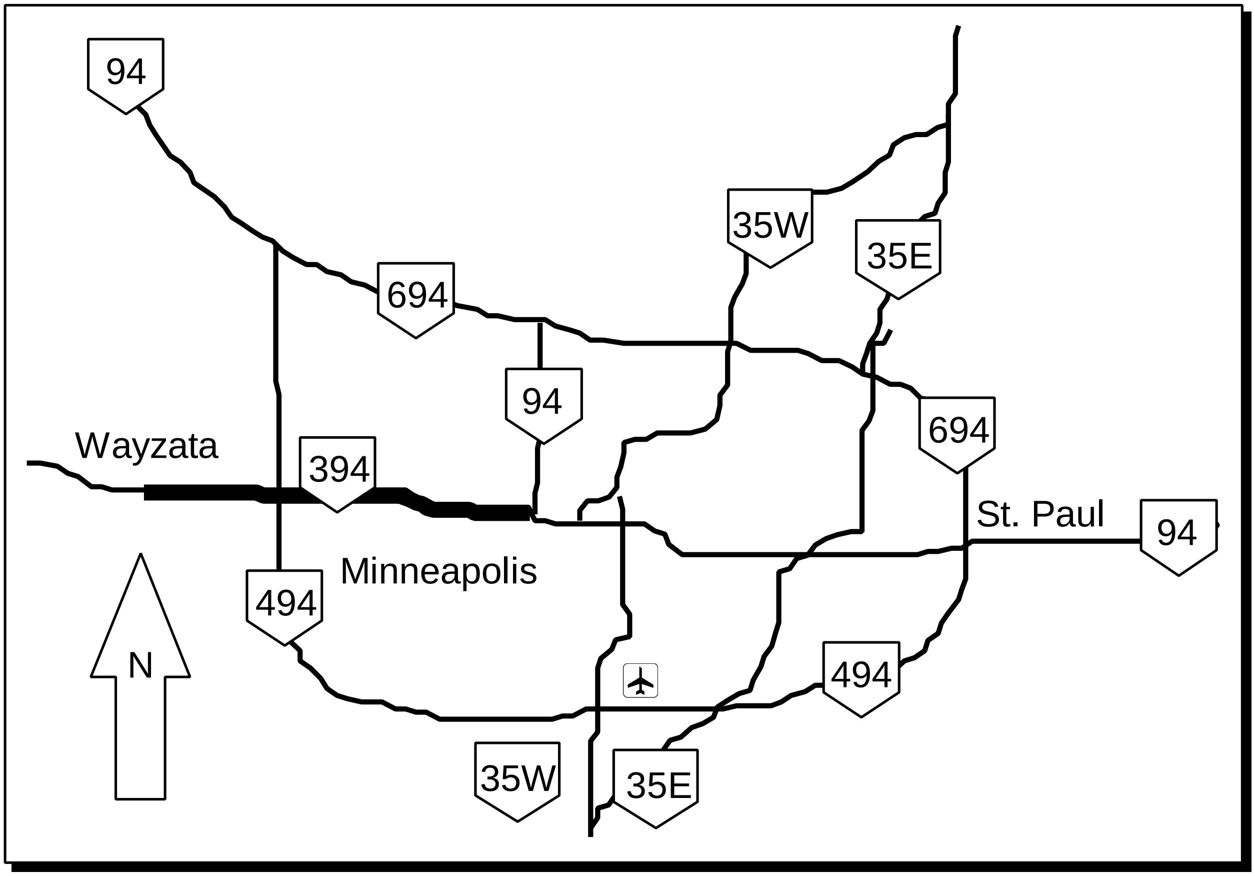


Figure 1: TRAVLINK Test Area

The evaluation consisted of the following:

- Collection and analysis of data about the project objectives
- Collection and analysis of data about site characteristics
- Compilation of a chronology describing the implementation and operation of the test
- Recording of external factors that might influence the test findings and results.

Results

TRAVLINK made significant strides towards improving transit information for commuters with the use of the kiosks, signs, and personal computers.

- TRAVLINK was an early demonstration of the use of multiple APTS technologies. This demonstration provided information to commuters about the location and status of buses that they planned to board, along with real-time traffic conditions and other static traveler information.
- Enhanced security was demonstrated during an incident involving a bus driver who was being threatened. The driver activated the "silent alarm," an MCTO police officer who was nearby investigated, and the perpetrator was arrested.

Significant obstacles, primarily funding limitation, MCTO operations cutbacks, a 3-week bus strike, and the limited test area (I-394 corridor only) resulted in moderate use of the kiosks, limited use of the electronic signs, and declining on-line use during the 12-month period. There was general agreement among the partners that if such a system were to be implemented on a permanent basis more benefits would be realized.

Legacy

The project ceased operation after the test was completed. MnDOT intends to transfer the kiosks to the Duluth area for inclusion in their public transportation upgrade program as part of the Guidestar statewide ITS program.

Test Partners

3M and Rennix

ETAK

Federal Highway Administration

Federal Transit Administration

Metropolitan Council Transit Development

Metropolitan Council Transit Operations

Minnesota Department of Transportation - Guidestar

Motorola

Transportation Management Solutions, Inc. - formerly Westinghouse

US WEST

References

Cambridge Systematics, Inc., TRAVLINK Operational Test Evaluation Report; August 1996.

Cambridge Systematics, Inc., TRAVLINK Operational Test Institutional Analysis;

ITS Field Operational Test Summary

Trilogy Advanced Traveler Information System Operational Test (Trilogy)

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

Trilogy is an Advanced Traveler Information System (ATIS) ITS Field Operational Test. The Minnesota Department of Transportation (MNDOT) Metro Division is conducting the test in the Minneapolis - St. Paul area (Twin Cities). The Trilogy test broadcasts traffic information about the Twin Cities expressways to in-vehicle devices. The test participants include commercial users (couriers and other high-mileage drivers) and commuters.

Project Description

The test aims to maximize the efficiency of the existing highway network by using an innovative means of providing traffic and travel information.

The test provides in-vehicle devices that deliver information in map-graphic and icon format (AB Volvo Dynaguide) to approximately 150 drivers from 5 companies, and approximately 30 private users (commuters). Test personnel ask the participants to first spend time with the Volvo devices using Radio Broadcast Data System (RBDS) format. After a period of using the RBDS device, test pesonnel then ask participants to use the FM Subsidiary Carrier Authorization (FM-SCA) technology. The RBDS format provides traffic information on three levels: symbols, signs, and text. The FM-SCA format provides the complete functionality of the RBDS format plus continuously updated traffic density or speed information for selected ½-mile segments of the road network. Switching formats gives the participants experience using both technologies so they can more objectively compare the two.

Test personnel evaluate user reaction and acceptance of the technology using telephone surveys and focus groups. Other test activities include a technical evaluation, the documentation of potential liability issues, and the documentation of the project’s cost.

Test pesonnel obtain and format up-to-date traffic information and deliver it to the particpating radio station. The radio station broadcasts traffic information via a FM subcarrier frequency from a local radio station using the RBDS and the High-Speed, FM-SCA technologies. Test evaluators expect travelers to use the information to make informed choices about route selection. During and after using the technologies, test personnel conduct interviews and focus sessions with the travelers to determine their perceptions of the systems. Test personnel also elicit suggestions from the participants for improvements to the system. Figure 1 shows the test configuration.

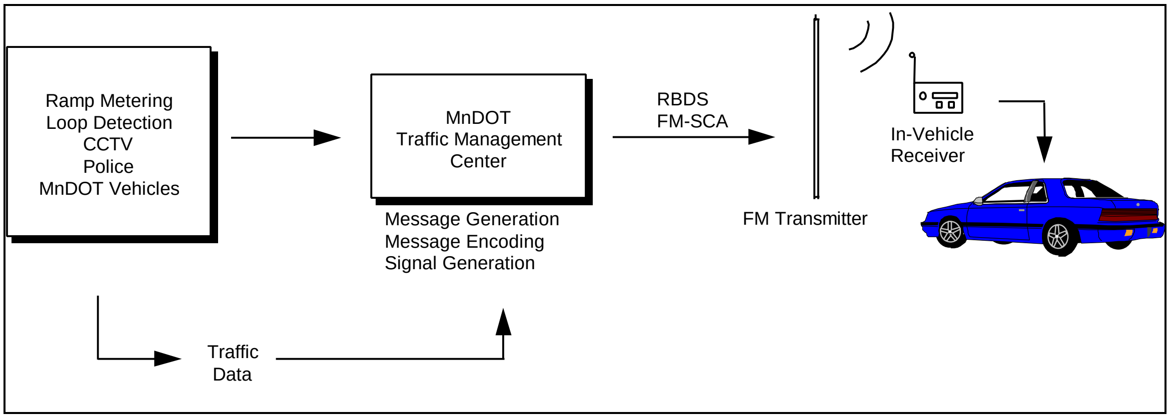


Figure 1 Trilogy Operational Test Configuration

The Trilogy test intends to accomplish several important goals. The test is demonstrating the potential of the subject technologies to provide useful travel information to improve travel decisions by commercial, government and private users. The test hopes to demonstrate the ability of the technologies to chage traveler behavior because of having better traffic information. Test evaluators hope to understand the potential effect of these changes on the Metropolitan Transportation System. The test is promoting a better understanding of the technical performance characteristics of the subject technologies. Moreover, it is helping determine the basic costs for deploying the system across a major metropolitan area.

Test Status

The test provides daily benefits to a significant number of users. The results of data collection from 100 commercial users of the RBDS format devices have produced several important findings at the midway stage of data collection.

Trilogy performs well. The tested devices dependably provided users with both accurate and reliable traffic information. Users consider the information to be of better quality than previously available sources. Positive user assessment increases, in some cases significantly, with an increasing weekly proportion of freeway and highway driving. This increased freeway-driving time generally signals greater user need and opportunity to use real-time traffic information.

Using Trilogy provides travelers with added value in the form of a perception of increased comfort and safety. Most users felt that having the improved traffic information provided by the Trilogy device translated into perceived stress reduction, improved safety, and added comfort.

Devices that would provide information in a text/voice format were not delivered, and that component of the test was eliminated.

The vast majority of users view the Trilogy-supplied traffic information to be of high quality. Users have come to rely on it as their premier source of traffic information. The multi-formatted Trilogy information output satisfies the needs of a majority of in-vehicle device users. Having multiple formats is the preferred output and most device users readily comprehend the information and use it daily. A majority of users expressed satisfaction with the usefulness and ease of comprehension of the existing information.

Most experienced users view almost all device features and functions as highly useful and not requiring improvement. Users are content with the existing features. They have not made suggestions for additional features or functions or suggested changes to existing hardware. Users have identified a few aspects of the system that should be improved, including device coverage area limitations and restricted text message access.

Perceptions of operability, in terms of user friendliness, vary considerably. Users consider the hardware components that require significant user intervention as the hardest to use. Users understand the graphic message components more readily than the text-based information.

Users were able to define reasonable price ranges for Trilogy product and service. They could not readily justify a personal purchase of the system. The limited user segment that spends the majority of work-related driving on freeways is willing to purchase the system.

The managers of the commercial drivers noted changes in travel-related efficiency and productivity, but were unable to isolate and quantify the impact of the test device. Some managers perceive added value in terms of driver comfort and safety.

Test Partners

AB Volvo

Differential Correction Systems

Federal Highway Administration

Minnesota Department of Transportation

References

Booz·Allen & Hamilton Inc., Advanced Traffic Information System Operational Test (Trilogy) Project Overview, February, 1996

HNTB, Trilogy Interim Evaluation Report, April 1997

ITS Field Operational Test Summary

Wisconsin/Minnesota Automatic Out-Of-Service Verification

FHWA Contact: Office of Motor Carrier Safety and Technology, ITS CVO Division, (202) 366-0950

Introduction

The Wisconsin/Minnesota Automatic Out-Of-Service Verification ITS Field Operational Test created, tested, and evaluated the use of an automated, real-time system providing access to data about commercial vehicles and/or drivers placed Out-Of-Service (OOS). The test aimed to increase the effectiveness of OOS enforcement and to establish and coordinate a bi-state enforcement program.

The tested system operated along a 252-mile section of westbound Interstate 90 and Interstate 94 in Wisconsin and Minnesota. The actual testing phase of the project occurred from June 1, 1995, to June 30,1996.

Project Description

The OOS verification system was established at four inspection stations on the I-90/I-94 corridor, three in Wisconsin and one in Minnesota (See Figure 1). As a commercial vehicle proceeded through one of the four inspection stations (safety and weight facilities) along the test corridor, a scanner read the license plate. The system compared the reading to licenses contained in an OOS vehicle database using specially designed software operating on a personal computer (PC) at each station. If the software found a match of the reading, the system sounded an alarm to inform inspectors. Inspectors could then take whatever action necessary to insure that the problem that had caused the driver or vehicle to be placed OOS had been corrected. State Patrol inspectors in both states had electronic access to the shared OOS database.

The test maintained the OOS vehicle database on a mainframe computer in Wisconsin. All inspection stations involved in the test were linked to the mainframe in real-time. The system updated the OOS database on the PC using a download from the mainframe. The update occurred frequently enough that a truck that was put out-of-service at a downstream station and then left the station would be identified at the next upstream station.

The evaluation of the system tested the achievement of three goals:

- Increase the effectiveness of OOS enforcement efforts
- Establish a bi-state enforcement program
- Identify potential future applications

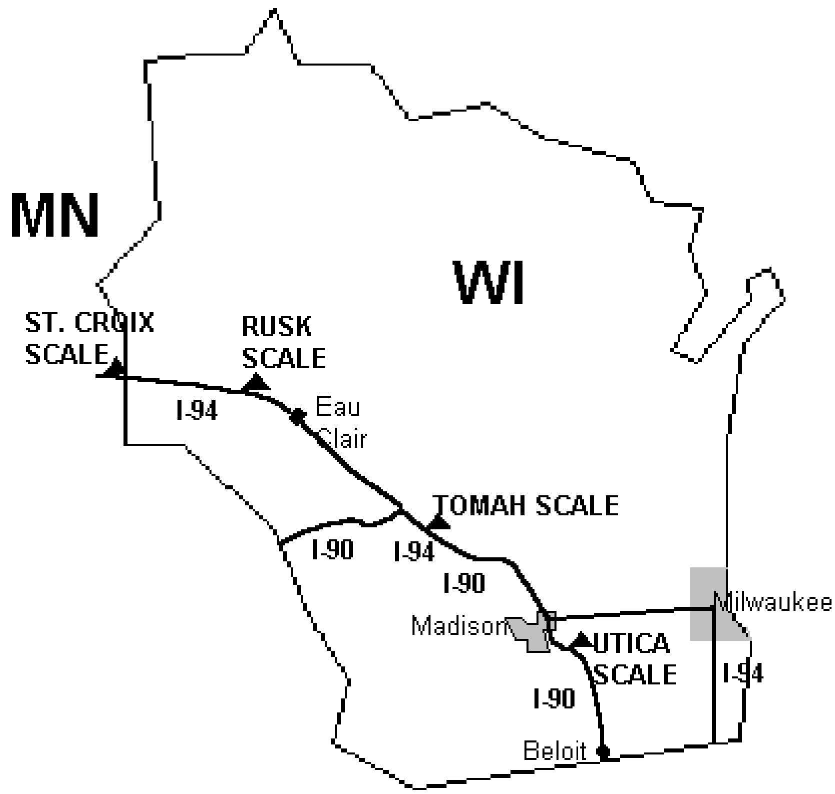


Figure 1: Location of Operational Test Inspection Stations (at scales)

Results

The test measured the effectiveness of the enforcement efforts in Wisconsin by several statistics. These statistics included the number of vehicles screened for inspection and the proportion of OOS violations found during inspections. The use of the automated scanner to read license plates produced a significant increase in the number of queries to the violation database. This increase alone served to increase the effectiveness of enforcement by checking significantly more vehicles for possible violations than had been possible using manual methods. Although possibly not the direct result of the tested OOS system, the number of inspections that found OOS violations increased by a small amount. Compared to the same quarter of the preceding year, the percentage of inspections resulting in OOS violations increased between 2.1 to 5.2 percent among the different inspection stations. In addition, the proportion of inspections finding non-OOS safety violations also increased at the three locations. The test indicated that using the system could potentially increase the proportion of OOS violations found during the regular inspection process.

Prior to the test, available data on OOS violations showed that encountering a driver and vehicle at an inspection station that was “operating OOS” was a rare event. In fact for all inspection sites statewide during the operational test, of 31,401 inspections conducted only 37 found a driver or vehicle operating OOS. The test personnel felt that the increased scrutiny of trucks and the higher likelihood that inspectors would discover OOS vehicles caused more drivers to use by-pass routes to avoid the inspection stations. Therefore, during the test and despite the increased enforcement effectiveness, “operating OOS” continued to be a rare event. Test personnel concluded that the tested system did not have an impact on identifying drivers operating OOS.

The project successfully established a bi-state enforcement program. In addition to the three installations at scales in Wisconsin, test personnel installed the system at the St. Croix scale in Minnesota. The test established and maintained a real-time link to Wisconsin’s mainframe computer. Minnesota inspectors regularly accessed the database using the same real-time link as their Wisconsin counterparts. The test results suggest, however, that a data quality (costly), real-time link to the Wisconsin mainframe database was not essential for the effective use of the system at the St. Croix scale. A connection to the mainframe using a modem and a standard telephone line would have been similarly effective at a much lower cost.

In terms of number of potential OOS violations, the operation of the system at St. Croix produced approximately the same level of identifications as was found at the Wisconsin stations. This result shows that the data sharing across the state boundary creates similar opportunities as within Wisconsin.

The largest potential benefit from the OOS database system is likely to be the benefit from integration with the SAFER system. (SAFER is a national database maintained by the USDOT that provides carrier and vehicle safety information electronically at the roadside.) Currently about 95% of the license plates read by the tested system provide no information about the vehicle or the driver (the vehicle is not OOS). By creating a link to the SAFER system, many of these license plates could be used to access safety information. Inspectors could then select for inspection vehicles that have a higher probability of being OOS or of having other safety violations.

The test personnel made considerable effort to evaluate the accuracy of the license plate scanners. The level of accurate readings as a percentage of all vehicles was only 36 to 43%. This level was substantially less than expected for several reasons. In some cases, trucks followed each other too closely (“tailgating”) for the scanner to observe the license plate. The scanner sometimes mistakenly triggered on a component of the trailer, rather than the rear of the trailer, particularly for slow moving vehicles. Some license plates (between 24 and 30 percent) were so damaged of dirty that the scanner could not read them. Finally, some state’s license plates were more difficult to read (notably Minnesota’s) because of the background color or design or the use of non-alphanumeric characters.

Test personnel recommended that additional research in several areas:

- Integrating the tested system with the SAFER system;
- Determining the benefits of collecting planning related data;
- Evaluating the potential for expansion of the system to other regulatory issues and to other inspection stations; and
- Developing an effective methodology for using the system in mobile vehicle enforcement.

Legacy

Two of the three installation sites in Wisconsin experienced such poor license plate recognition success rates that they stopped using the system when the test concluded. The third site had success and continued to use the system until it stopped functioning due to a need for repairs. Wisconsin DOT will not repair it and the system has been shut down.

Test Partners

Federal Highway Administration

Minnesota Department of Public Safety

Minnesota Department of Transportation

Preceptics, Inc.

University of Wisconsin at Madison

Wisconsin Department of Transportation (Project manager)

References

Smith, Jr., Robert L.; MN/WI Automatic Out-Of-Service Verification, Final Report, June 1997